SCIENTIFIC AMERICAN

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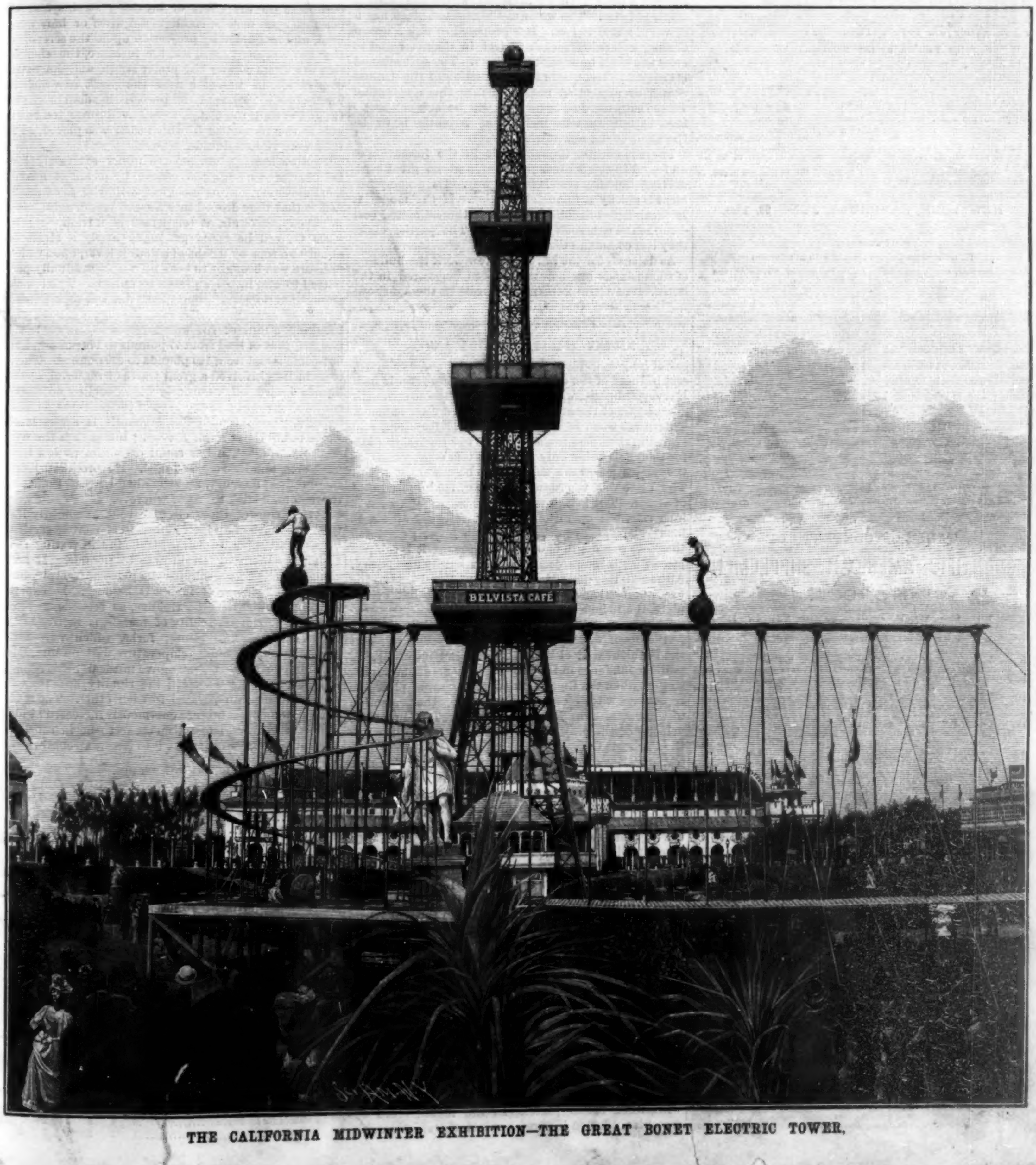
THE CALIFORNIA MIDWINTER EXHIBITION.

The rapid creation of the White City at Chicago was a remarkable achievement, but even this wonderful feat of the skill of the architect and the engineer is transcended by the rapidity of transformation that took place at the San Francisco Midwinter Fair. Last August the western portion of Golden Gate Park was almost a wilderness made up of sand dunes and scattered trees. Under the hand of the landscape gardener, the park has been transformed into a veritable Garden of Eden and a dream city was created in five months. A city has grown up in the midst of many palms and broad-leaved tropical plants and almost within sound of the breakers which dash against the cliffs that guard the Golden Gate.

Following so closely upon the great Columbian Exposition, the Midwinter Fair has not attracted the attention that its merit deserved or that it would have received had it been held at any other time. The financial depression has also prevented great numbers from visiting it, who, at a more propitious season, would have made a pilgrimage to San Francisco. We have from time to time published views of the buildings and grounds, so that a good opportunity has been afforded the readers of the SCIENTIFIC AMERICAN of judging of the extent and merit of this great achievement. Many of the exhibitors at Chicago sent their wares directly to the California Fair, and a visitor there would easily recognize many familiar scenes from the Midway Plaisance. He could attend, if he pleased, the fantastic nuptial ceremonies that took place each noontide in the Cairo Street. He could, if it gave him pleasure, watch the contortions and so called dances of the Oriental houris from the civilized East or the barbarous but less offensive war dances and songs of the Samoan warriors. Then there are many scenes of interest illustrative of early California life, the camp of the Forty-niners, with full

(*Continued on page 393.*)



THE CALIFORNIA MIDWINTER EXHIBITION—THE GREAT BONET ELECTRIC TOWER.

Scientific American.

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(Illustrated articles are marked with an asterisk.)

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SCIENTIFIC AMERICAN SUPPLEMENT

No. 964.

For the Week Ending June 23, 1894.

Price 10 cents. For sale by all newsdealers.

PROPOSED RAILWAY FROM INDIA TO CEYLON.

The island of Ceylon is one of the most valuable possessions of the British Empire. It has an area of over twenty-five thousand square miles, and a population of over three millions. Great progress has been made within the past few years. Railways and telegraph lines have been extended. The people are industrious and education is making progress.

Ceylon is situated off the southeast side of the extremity of India, and the island is supposed in past geological ages to have formed a part of the mainland, between which and Ceylon there are now some islands and some reefs. The depth of water on the latter is small. A railway is now projected to connect Ceylon with India. It is estimated that the waterway requiring to be bridged is about thirty miles in extent. The whole work, it is supposed, will cost not more than $5,000,000.

THE ISLAND OF ATLANTIS.

Among newly projected enterprises is one for the formation of an island, ten or eleven miles out at sea, off the coast of Long Island, with the object of establishing there a summer hotel, for the benefit of citizens who wish to keep cool and avoid mosquitoes during hot weather. The projector of this enterprise, Mr. Charles Coen, and a party of coadjutors went out recently in a steamer and selected the spot, planting thereon a buoy with an attached white flag with a single red star. The water at the selected place has a depth of about 70 feet. It is proposed to sink a group of sixty iron caissons each 15 feet in diameter and to erect the hotel building upon them. The spot selected is claimed to be outside the jurisdiction of the United States or any other nation; hence the corporation will be subject to no taxes and will be subject to no laws except its own legislation. Atlantis is to be the name of the new territory.

There is nothing impracticable in the formation of an island in the manner proposed, and no great engineering difficulty stands in the way. Its accomplishment is chiefly a financial question. If the money is forthcoming—one million dollars is the estimated cost—the island can soon be created. The parties claim they can command the funds.

As defenses for the harbor of New York the building of such islands has heretofore been suggested in the SCIENTIFIC AMERICAN, and illustrations thereof showing the method of construction have been presented.

RECENT TRIALS OF NAVAL ARMOR.

Not long since there was chronicled in our columns, and in those of the daily press, the failure of an 18 inch Harveyized plate, which was tested by the government as a sample of the armor plate for the cruiser Indiana. This plate was 7 feet 6 inches wide, 16 feet long and varied in thickness from 18 inches to 8 inches, the latter thickness being only at the bottom edge, which, as the plates go on the ship, was to be under the water. The plate was the representative of six hundred tons of armor. The attack was to have been made by a 13 inch rifle, but operations were commenced with a 12 inch rifle. The projectile from the latter penetrated the plate to a depth of 8 inches, breaking it into three pieces, while the projectile suffered hardly any injury. Although this proved the plate unable to stand the test, another shot was taken at what was left of the plate, the 13 inch rifle being employed.

This completely destroyed the plate, while the projectile itself was shattered to pieces. The test cost the Bethlehem Steel Works $20,000, and, naturally, impaired confidence in the product of the manufacturers, so that when the time came to test sample plates to represent 650 tons of curved armor for the protection of the battle ship Massachusetts, a reduction of the velocity of the projectile was pleaded for. But when the Carnegie Company, of Pittsburg, offered to submit one of their own plates to the trial, the Bethlehem Company faced the encounter and submitted a 17 inch plate. The results obtained in the trial, which took place at Indian Head on June 12, were truly remarkable, and showed that a Harveyized plate possesses the highest possible qualities. The same 12 inch rifle whose projectile had demolished the large Harveyized plate in the preceding trial was used. The first shot struck the plate almost normally to its surface, penetrated it a distance of six inches without developing any cracks in the plate or bulging it in the rear. The Carpenter projectile was broken to pieces, small fragments flying 200 yards. A second projectile, fired at a higher velocity and caused to strike in another place, penetrated about ten inches, producing only one very fine crack, and the plate was left in condition for further service. Authorities in England have been much exercised over Harveyized plates, as it has appeared that the United States government, by the use of this process, is producing armor superior to any other.

It is noted by authorities, however, that in England there have been very many great disappointments with thick armor plates. In the manufacture the metal is subjected to enormous internal strains in the cooling process, which are liable to produce a plate under very high and irregular stresses. Such thick and enormous masses of metal, especially where they vary in thickness, inevitably cool irregularly, and then the use of subsequent hardening processes subjects them to still further strain. It is conceded that the system used by our government of testing sample plates selected from the lot by their own officers enables us to arrive at a much better judgment of the value of our armor than do any tests which have hitherto been applied abroad.

It causes a shock to the rational mind to see the amount of metallurgical skill which is devoted to the manufacture of armor plates and projectiles designed for offensive and defensive purposes only. The modern projectile of the finest steel turned to accurate shape is almost a work of art, yet its sole uses are to destroy an armor plate as fine a piece of work as the shell in its own way, or worse yet, to destroy life. The above may sound like platitudes, but it is a strange spectacle to see the talents of the engineer devoted to destruction.

How Metals are Affected by Very Low Temperatures.

Before the Royal Institution Professor James Dewar recently delivered a lecture, in which he dealt with the properties of solid bodies, especially of metals, as affected by very low temperatures. He began with experiments on the effect of breaking strains and of pressure upon metals; small metal wires or bars were used, and magnified by projection upon the screen, so that those present could see, for instance, the elongation of a small copper bar under strain, and its extra contraction in diameter near the point at which it finally broke. By applying pressure to small blocks of tin and of lead, the metals were forced through a small hole in the receptacle in which each was placed, as if they were viscous liquids.

To show how metals behave under extremely low temperatures, he applied strain, by means of a commercial cement-testing machine, with the jaws modified so that they dipped into a small vessel containing liquid oxygen or air, at temperatures of from −180° to −200° C., and he could gradually apply a strain of about two tons by means of a double lever, upon which pressure was brought to bear by water gradually permitted to run into a suitable receptacle. The tensile strength of non-crystalline metals was greatly increased by low temperatures. He said that at −180° C. the breaking strain of tin was increased from 200 to 400 pounds, that of lead from 77 pounds to 170 pounds, and of fusible metal from 140 pounds to 450 pounds. These experiments involved a great waste of material, as the liquids boiled off vigorously while cooling down the containing vessel and the jaws of the machine, so that, he said, "some people think that it is a very large waste to obtain so small a result; but such is the way of the world." Tin has small extension at low temperatures, and lead a great deal. He produced a few small rods of mercury, and they had a great tendency to weld and stick together wherever they came into contact. One of these circular rods, of slightly less than one-tenth of an inch in area in the cross section, broke at a temperature of −180° C. in the testing machine; its breaking strain was 31 pounds. It first elongated a great deal near its place of fracture, like lead, to which class of metals it belongs. By experiment he showed that the rigidity, as regards flexure, also the torsional rigidity of metals, is increased by cold. He took two tuning forks, which were synchronous at the same temperature, but on intensely cooling one of them, they gave musical beats which sounded at the same time; the rigidity and the torsional rigidity run parallel to each other. The magnetic powers of metals are enormously increased at low temperatures, and magnetism seems to be in some remarkable way directly related to tensile strength.

BREAKING STRESS.

	15° C. Tons per square inch.	−180° C.	15° C. Elongation per cent.	−180° C.
Copper	22·3	30·0	6·8	13·4
Iron	34·0	62·7	8·2	4·7
Brass	25·1	31·4	35·5	32·2
G. silver	38·8	47·0	10·7	20·4
Steel	35·4	60·0	29·4	19·5

Merits of Different Pavings.

The comparative merits of different paving materials for Chicago have been classified as follows by Mr. D. W. Mead:

	Asphalt.	Brick.	Cedar block.	Cobble stone.	Granite block.	Macadam.
First cost	5	4	2	1	6	3
Cost of maintenance	4	1	5	3	2	6
Facility of repair	6	2	5	4	3	1
Durability under traffic	4	1	5	3	2	6
Freedom from noise	3	4	2	6	5	1
Freedom from dust	1	2	4	5	3	6
Freedom from decay	5	1	6	3	2	4
Freedom from absorption	1	2	6	4	3	5
Foothold for horses	6	4	5	1	2	3
Ease of traction	1	2	3	6	5	4

Foreign Competition on Cottons.

According to an article in the *Boston Commercial Bulletin*, the cotton cloth industry prospects in the United States are far from rosy. Increasing pressure of foreign competition on our markets, foreign and domestic, seems to be the destiny of our cotton manufacturers.

The industry in Europe is particularly depressed.

At the international meeting of textile workers at Roubaix, France, last November, the official reports told a terrible tale of foreign wages in the cotton industry. The weavers of Manchester, England, according to this report, earn on the average $6.63 for a week of 56 hours. The spinners average $8.53, the girls from eighteen to twenty years earning $4.30 to $4.50. Piecers earn on an average $4.38 a week, and bobbin boys $1.76 to $1.95.

In France the daily wage for fourteen hours' work, in Cambresis and the Department de l'Aisne, is 13¾c. to 19½c. for weavers.

The representatives of a large German factory employing 1,500 hands and running 90,000 spindles reported the average earnings of girls and women at $1.45 for a week of 66 hours.

The capitalists of England conceived the idea that operatives who required no clothing worth mentioning, and no food but oil and rice, could work more cheaply even than these unhappy toilers. So they established large factories at Bombay for the manufacture of the coarser cotton yarns.

The experiment was successful, and Manchester is suffering from the competition of Bombay, not only in India, but also in China.

More recently Japan has come to the front, and is taking the China trade away, not only from Manchester, but from Bombay. Last year there were 360,000 spindles in operation in Japan, and by the end of this year 750,000 will be turning.

The factories in Japan are at Osaka. They have the advantages of cheap coal, cheap skilled as well as unskilled labor, and a fixed rate of exchange, both Japan and India being on a silver basis. The average wages are 16·2 cents per day for male operatives and 8 cents per day for females. The prices on Japanese cotton yarns at Shanghai and Hong-Kong are cut sharply below both Manchester and Bombay rates, but the Mikado's country is doubling its machinery yearly and already has nearly as many spindles as the State of Maine.

The Old University Building—Its Once Distinguished Occupants.

The old gray granite building on University Place, facing Washington Square, which until a few weeks ago was the home of the University of the City of New York, is now in process of demolition. For a long time, as time is measured in this quick-moving new world of ours, the building has added character to a very picturesque part of the city; but new times and new needs have come, and now the University is to be removed to a new site beyond the Harlem River, and the familiar old building itself is to be replaced by a tall and stately business building. For nearly sixty years, or since its completion in 1835, the building has not only sheltered the schools of the University, but it has been the home of many men who have achieved fame in literature or art, and within its high-ceilinged rooms some of the most important inventions of the nineteenth century—inventions of great influence upon the advance of civilization or the betterment of mankind—have been made or perfected.

In the front room on the third floor of the north wing of the building Morse made his perfected apparatus for the transmission and recording of messages by electricity. Samuel Finley Breese Morse was born in Charlestown, Mass., on April 27, 1791. He was graduated at Yale in 1810, where, while an undergraduate, he received his first instruction in electricity. Upon leaving college he studied art under Washington Allston, whom he accompanied to Europe. He was admitted into the Royal Academy in 1812, but he continued his studies under Allston and under Benjamin West, and in 1813 he gained a gold medal for a plaster model of the "Dying Hercules." Soon after he returned to America, and he practiced his profession with varying fortunes for many years. In 1818 he wrote to a friend from Charleston, S. C., that he was "painting night and day." In 1823 he returned to New York, thereafter, except for a few occasional absences, to make this city his home. He was one of the founders of the National Academy of Design, and became its first president, serving in that capacity for a number of years. He again visited Europe for purposes of study, his wife having died meanwhile. On October 1, 1832, he sailed from Havre for home on board the packet ship Sully.

While on board ship Morse, in conversation with a fellow passenger, learned something more of the power of electricity and the possibility of its almost instantaneous transmission through wire or other suitable conductors, and with his quick intelligence and foresight he perceived that human intelligence might control this power. It was so that the idea of the electric telegraph first came to him, and with characteristic energy he began at once to develop it, and before the ship had arrived at New York he had conceived and formulated the dot and dash system of transmission. In New York Morse then lived for two or three years in one room provided for him by his brothers, in a building on the corner of Nassau and Beekman Streets. He endured many hardships, but he worked constantly upon his models and plans. In 1835, however, he was appointed professor of the literature of the arts of design in the University, and in the same year he was able to show to his friends a working model of his invention, and also the relay magnet which he had designed to re-enforce the electric current upon a long circuit. In September, 1837, the instruments were shown to visitors in the cabinet of the University and messages were then sent from instrument to instrument over 1,700 feet of wire arranged about the room. On May 24, 1844, Morse, stationed in the chamber of the Supreme Court in Washington, received a message sent to him from his assistant Mr. Vail, in the Mount Hope depot in Baltimore. The message was dictated by a daughter of H. L. Ellsworth, the then Commissioner of Patents, and was "What hath God wrought!" Numbers xxiii. 23. The telegraph was offered to the government for $100,000, but this offer was declined, although Congress at length appropriated $8,000 for the cost and maintenance of the line then in existence. For a while Morse had other hardships to endure, and his title to his invention was disputed; but his rights were finally settled by a decision of the Supreme Court of the United States. There are now said to be 2,000,000 miles of telegraph wires in operation in the world, in addition to 150,000 miles of submarine cables, and in 90 per cent of the connected offices the Morse instruments are in use. For many years after the demonstration that his invention was practicable Morse lived, secure in the esteem and admiration of his countrymen. He died in this city on the 2d of April, 1872. Upon the front wall of a house on the north side of 22d Street, a little west of Fifth Avenue, a tablet recounts simply, "In this house, S. F. B. Morse lived for many years and died."

While in Paris, during one of his later trips, Prof. Morse made the acquaintance of Daguerre, who was then experimenting with photography or the effect of sunlight upon sensitized silver plates. Morse had previously experimented unsuccessfully in the same direction; but he learned the process of Daguerre, and working to improve his own knowledge as he could at intervals, he was, at length, able to take a sun picture. He was the first to do so in this country. Morse told of his discovery to John William Draper, who was then a fellow professor of his in the University. Prof. Draper had studied the effect of light upon organic and inorganic matter, and he improved upon the knowledge so conveyed to him, and he was the first to take a photograph portrait from life, Daguerre having confined his attempts to landscape. Prof. Draper's sitter was his sister, Miss Dorothy Catherine Draper. Her face was powdered and the lines upon it drawn, and the sitting was long and arduous.

John W. Draper was born at St. Helens, near Liverpool, on the 5th of May, 1811. In 1832 he came to America. When the University was organized the faculty asked the authorities of Yale and other colleges to suggest a man able to become the professor of chemistry in the new University, but they could not. The faculty were in difficulty until one of the number recalled some papers upon chemistry he had then recently read, of which Draper was the author. It was then that he was elected to the chair. In 1837 he was elected professor of proposed medical department of the University; but the financial troubles of that year caused an abandonment of the project for the time; but in 1839 he was elected president of the Medical College, retaining that position until 1872, but continuing his lectures until 1881. He died at Hastings-on-Hudson, January 4, 1882.

Prof. Draper was associated with Morse in the development of the magnetic telegraph, and the series of experiments conducted by him in the laboratory of the University was the first to establish with certainty the practicability of utilizing electricity for sending messages over long distances.

Samuel Colt was another inventor who once made his home in the old building. Colt was born in Hartford, Conn., on July 19, 1814. He began work in his father's factory, but he early ran away from home and shipped as a sailor before the mast. In 1829, when only fifteen and while upon an East Indian voyage, he made the first model of his revolver. Returning home, he again entered his father's factory, and in the dyeing and bleaching acquired an accurate and extensive knowledge of chemistry, and this knowledge he put to use and profit immediately when he delivered lectures throughout the United States and Canada. The money he made in this way he devoted to the perfection and manufacture of his models. In 1835 he patented his invention, and, with some New York capitalists, formed a company, under the name of the Patent Arms Company, with a capital of $300,000, for the manufacture of his revolvers. The government objected to the arm at first, because of its supposed tendency to explode several chambers at once and for other reasons, but Colt was able to modify and improve his invention, and in 1837, when Lieut.-Col. Harvey was at war with the Florida Indians, a few of the troops armed with this weapon were able to drive the Indians from the Everglades. The conclusion of the Seminole war stopped the sales of the revolvers, and the Patent Arms Company was forced to suspend. In 1847 Gen. Taylor sent to Colt for a supply for use in the Mexican war. Colt had in the meantime parted with his last one to a Texan ranger, and had to make a new model, after advertising in vain for an old one. In this model several new improvements were made, and the government duly adopted the arm. Other improvements were made after the Crimean and other Indian wars until the weapon assumed its almost perfect shape. Col. Colt died on January 10, 1862.

Prof. Martyn Paine, who also lived in the University, although not an inventor, should be remembered for his services to humanity. He was born in Williamstown, Vt., July 8, 1794. After graduation he practiced medicine, at first in Montreal but later in this city. In 1841 he united with other physicians in establishing the University Medical College, now the medical department of the University. Dr. Paine was the author of many books upon medical subjects, and was mainly responsible for the passage of the law permitting the practical study of anatomy. Until 1854 a very stringent law was in existence forbidding the dissection of the human body. A bill was introduced in the State legislature repealing this law, but its passage was doubtful. At the earnest solicitation of his colleagues, Dr. Paine went to Albany and for three months labored with the members of the legislature, removing their prejudices and explaining the benefits which would follow its passage. He was at last successful. Dr. Paine's long and useful life ended in New York on November 10, 1877.

Electric Photography.

In the May number of the *Cosmopolitan Magazine*, Prof. A. E. Dolbear makes the following suggestive remarks on the above subject:

For a long time it was believed there were three different kinds of ether waves, known as heat, light and actinic rays. The latter were supposed to be the ones that produced the chemical action on photographic plates, while light consisted of rays of a different kind, capable of affecting the eye. It was discovered, however, that the same rays that can produce vision can also heat a body, and also do photographic work, and what any ray can do depends upon the kind of matter it falls upon, so that all rays have similar characteristic properties. This discovery makes it plain that there is no peculiar kind of ether waves which can be called light, as distinguished from other kinds of ether waves. What is called light is a physiological phenomenon, and has no existence apart from eyes. So well assured is this, that the serious proposal is made to banish the word "light" from physics.

The sensitive coating upon a photographic plate is an unstable chemical compound, which may be broken up by mechanical pressure, by heat, or by ether waves. The proper wave length for a given plate depends upon the nature of its surface. The tanning of the skin, the darkening of newly laid shingles, the coloring upon apples and other fruits, is a photographic process, as can be shown by shielding them from the sun's rays. It has long been known by photographers that pictures may be taken with ether waves much too long to be seen by the eye, if some other substances are used in place of the simple silver salts in common use.

Since it has been shown that ether waves of all lengths have an electromagnetic origin, it has been apparent that all the effects of light can be duplicated with suitable electric apparatus. Lay a coin, like a half dollar, on a plate of glass and let a few sparks from an electric machine fall on it. Remove the coin, and the glass surface will not appear to have been affected; but if it be breathed on, the image of the coin will at once be seen, and that it is really engraved on the glass surface is evident, for it will not easily rub off. If a piece of photographic paper takes the place of the glass, it must have the imprint of the coin made upon it. It is not needful to have the sparks fall upon the coin, for, if it be inclosed in a dark box, brought near to an electric machine having short sparks passing between its knobs, the ether waves set up by the latter will be sufficiently short to affect the photographic surface, which may be developed afterward in the ordinary way. So it is actually possible to take a photograph of an object in absolute darkness, with the ether waves set up by working an electric machine. Not much has yet been done in this direction, but it is a new clew to chemical possibilities, and one may confidently look forward to the time when the qualities and colors of surfaces of many things will be changed to suit the taste by an application of electric waves of suitable length to bring about the proper chemical reactions, and an electric machine may become a necessary adjunct to the apparatus of the photographer

AN EFFICIENT MAGNETO TELEPHONE.

Until lately, it has been generally believed that a magneto telephone could not be used to advantage except in connection with a microphone transmitter. This may be true of magneto telephones heretofore in use. Lately, however, a new telephone has been introduced by the Viaduct Manufacturing Co., of Baltimore, Md., which is adapted for use in manufacturing establishments, hotels, asylums and public and private buildings and small exchanges.

A number of exchanges in which these magneto telephones are used have been established in several small towns, among which are West Winsted, Conn., Great Barrington, Mass., Emporium and Laceyville, Pa., Reidville, N. C., Liberty, N. Y., Vineland, N. J., Clinton, Tenn., Gaffney, S. C., Suffolk, Va., and Newport, Pa. The number of subscribers varies in the different exchanges from ten to one hundred.

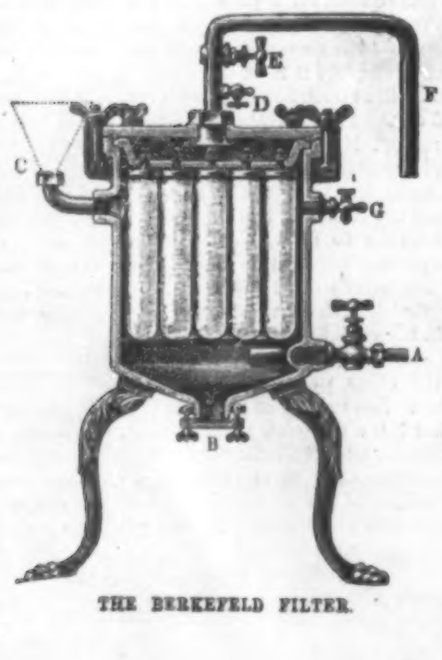
Our engravings show the combination magneto transmitter and call both closed and open. In the open view is shown the powerful magnet of the transmitter which is depended on for superior results. The small cut shows one of the switches used at the Central Office.

AN EFFICIENT MAGNETO TELEPHONE.

Purchasers of the Viaduct instruments, magneto bells, transmitters, receivers and switch board, it is said, run no risk of litigation, as the company claims not to make anything which infringes existing patents.

THE BERKEFELD FILTER.

A filter which will mechanically perform its work so well as to thoroughly sterilize water, necessarily at the same time removing all minor impurities, and which will operate so rapidly as to be practically applicable to the ordinary household supply faucet, without greatly delaying the flow, presents the first elements of merit, the further most essential practical matter being that such filter may be readily cleaned and kept in its state of original efficiency. Such a filter the Berkefeld Filter Co. claim to offer, Mr. August Geise, proprietor, No. 4 Cedar Street, New York City. The small figure shows a filter of this kind attached to an ordinary water faucet, and the larger figure represents a group of such cylinders combined in one, as might be necessary in hotels and large manufacturing establishments, with added appliances to facilitate the frequent and ready cleaning out of the filters. The filtering cylinder, or the filter proper, is made in several different sizes, with inclosing metal case and connections for attachment to the house supply service, the filter cylinder in the small illustration being 3¼ inches high and of 2 inches outside diameter. The prime merit of this filter lies in the peculiar quality of the filtering cylinder, which is made of infusorial earth from the kieselguhr mines of Hanover, Germany, composed of minute skeletons of diatomaceæ, and having an enormous number of exceedingly small pores, designed to intercept the flow of the minutest suspended organic or inorganic matter, while their hard silicious nature affords a firm and practically indestructible material. The pores are so minute as to be practically impassable by the minute germs which develop into the organisms causing putrefaction, fermentations, and the various zymotic diseases, and yet the filter may be easily cleaned, ordinarily by simply brushing off the surface of the filtering cylinder, or it may be thoroughly sterilized by being boiled in water, being gradually brought to the boiling point. The capacity of a single cylinder small filter is a gallon of filtered water in three minutes at a pressure of forty pounds, equal to about ninety feet head, and at other pressures in proportion. The larger illustration represents a large supply filter, especially adapted for hotels or manufacturing purposes, mineral water makers, brewers, etc., and provided with special facilities for easy cleaning. A is the inlet pipe, the filtered water passing out through F, and C represents a funnel through which a silicious wash may be introduced. An air pump is connected at D, and G and E are air cocks to be operated in connection with it, whereby suspended silica is made to do the internal scouring of the cylinders without removing them from the casing. Among the high testimonials commending this filter are the indorsements of Professors Koch, of Berlin, and Flugge, of Breslau, Surgeon-General Sternberg, of the United States Army, etc.

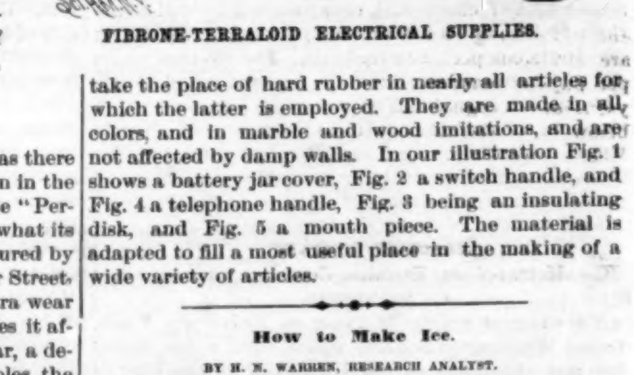


THE BERKEFELD FILTER.

AN IMPROVED TUCK MARKER.

In no class of sewing machine attachments has there been less improvement made in past years than in the tuck marker, and manufacturers will find in the "Perfection" all the elements required to make it what its name implies. This attachment is manufactured by the Perfection Tucker Company, of No. 2 River Street, Rochester, N. Y. It throws absolutely no extra wear on the machine to which it is attached, nor does it affect the operation of machine in any particular, a defect so prevalent in other markers. It enables the operator with a glance and turn of screw to instantly change from one width of tuck to another and back again, or to throw any desired space in or out. The marker is made of the best material, and is tested before leaving the works. The marker is fastened to the machine base with a single screw, and not to the presser-foot, as in most others, thereby avoiding unnecessary jar and wear on the attachment or machine on which it is used. The attachment itself is held in fixed position, it being unnecessary to tighten or loosen this screw for any purpose other than its application to or removal from machine.

The "Perfection" has the largest range of any in the market, as it will make tucks from ⅛ inch in width up to those of 2 inch, including a 1 inch space. The adjustment is accomplished by means of two screws on the "tuck and space" scale, located on the upper part of attachment, and in plain view of the operator. The screw on the left is used when marking tucks and that on the right when space is desired between tucks, and they are manipulated as follows: Let it be assumed that we are to make a combination of tucks and spaces as the following—¼, ¼, ¼ "tucks," ⅜, ⅛ space tuck; then the operation would be, first set cloth guide, which is part of attachment, to mark on its scale corresponding to width of first tuck desired, viz., ¼ inch; next, loosen left hand screw of "tuck and space" scale, and push scale out until it arrives at a point marked ¼, which is the one desired; tighten screw with thumb and finger, and attachment is set for ¼ inch tucks. Make first two, then loosen screw on right hand end of scale, push marker out until it arrives at a point marked ⅜, fasten screw; stitch third tuck, and we have now made three ¼ inch tucks and one ⅜ space; now proceed as above for remainder. This is absolutely all that is required on part of the operator to make any combination of tucks and spaces.



AN IMPROVED TUCK MARKER.

Simple Method of Sterilizing Water.

M. Traube states that by mixing water with chloride of lime in the proportion of half a milligramme to 100 cubic centimeters, all micro-organisms present are destroyed within the space of two hours. Water abounding in bacteria, after having been thus treated will be found perfectly sterile when tested in suitable culture media. The amount of active chlorine present is reduced within the two hours by about 9·1 per cent, and the remainder may be neutralized by the addition of sodium sulphite in sufficient amount—the addition of an excess would not be detrimental, as it would be soon converted into sulphate by the oxygen dissolved in the water. After treatment in this manner, water has a pure taste and a perfectly neutral reaction. Whether pathogenic bacteria are completely destroyed by such treatment has not been exactly ascertained.—*Zeitschr. Hygiene; Pharm. Jour.*

A NEW ARTICLE OF MANUFACTURE.

The illustration represents a few of many samples of goods put on the market within a comparatively recent period, and made from "fibrone" by hydraulic pressure by the Fibrone-Terraloid Co., of No. 97 Oliver Street, Newark, N. J. The goods have a polish equal to the finish of the dies, and are designed to take the place of hard rubber in nearly all articles for which the latter is employed. They are made in all colors, and in marble and wood imitations, and are not affected by damp walls. In our illustration Fig. 1 shows a battery jar cover, Fig. 2 a switch handle, and Fig. 4 a telephone handle, Fig. 3 being an insulating disk, and Fig. 5 a mouth piece. The material is adapted to fill a most useful place in the making of a wide variety of articles.

FIBRONE-TERRALOID ELECTRICAL SUPPLIES.

How to Make Ice.

BY H. N. WARREN, RESEARCH ANALYST.

To procure ice in the laboratory, even when intended to illustrate the same as an experiment, is generally brought about either by the clumsy method of mixing large quantities of the original compound with sodium or calcium chloride, and exposing to its influence the substance under examination; or when in larger quantity, by employing one of the costly refrigerators now upon the market. With a practical chemist all such apparatus is ridiculed. Take for the expensive refrigerator a fractional distillation flask; place the flask in the desired quantity of water which is intended to freeze, contained in a suitable receptacle. Through the neck of the flask is now inserted a rubber tube terminating in a glass point, which should all but touch the surface of the liquid contained in the flask, which consists of about 20 c. c. of an equal mixture of ether and carbon disulphide. The further end of the rubber is now connected to a pair of constant bellows, and a brisk current of air continued for about three minutes; almost immediately the thermometer will sink to zero, the vapor of the mixture introduced escaping through the small tubular of the flask, while the outside vessel, containing the water, will be found to have become inseparable, owing to the thickness of the ice formed. This constitutes a beautiful experiment for a lecture table, where the gradual development of the ice can be readily observed. By this means I have frozen a liter of water when the room was at 70° F. in half an hour.—*Chem. News.*

THE SIMONDS STEAM WAGON.

On account of electric and cable traction, not to mention the more humble bicycle, the tendency of the present day is that the horse must go, must go metaphorically, for his days of labor seem nearly passed. In the furtherance of this view, we illustrate a steam road wagon, in which steam is to do his work on country roads and city streets, something which has been for many years one of the foremost aims of the inventor.

The wagon was invented and patented by Mr. C. L. Simonds, of Lynn, Mass., and on four bicycle wheels with rubber tires is placed the body and machinery of the wagon. The machinery consists of a steam boiler of the porcupine type, built to carry 100 pounds of steam to the square inch. Small as it is, it has 28 feet of heating surface. A two-cylinder vertical engine works the main shaft, the two cranks of which are set at an angle of 90° with each other, so that there shall be no dead point.

The main shaft carries a sprocket wheel which is connected by chain with a sprocket wheel on the left hand rear wheel of the wagon. As the engine runs at a high speed, the sprocket on the wheel is of much larger size than the other, so as to reduce the speed. The total weight of the vehicle is 437 pounds. The front wheels are 36 inches in diameter, the rear ones 48 inches. They are rubber-tired. Two pumps are employed; one feeds the boiler, the other drives the air blast through the naphtha. Under the boiler are five burners, arranged so that they can be used singly if desired. Five gallons of naphtha, enough to run the wagon 100 miles, are carried. Steam can be made in five minutes. A steering wheel is provided in front of the seat. The exhaust steam is passed through a feed water heater, and is then delivered to the naphtha flame, where its presence destroys noise. No skill is needed in the management of the wagon, and it can make ten miles an hour, and climb hills with two passengers.

LIGHT STEAM ROAD WAGON.

THE PATROL WAGONS OF THE METROPOLITAN TRACTION COMPANY.

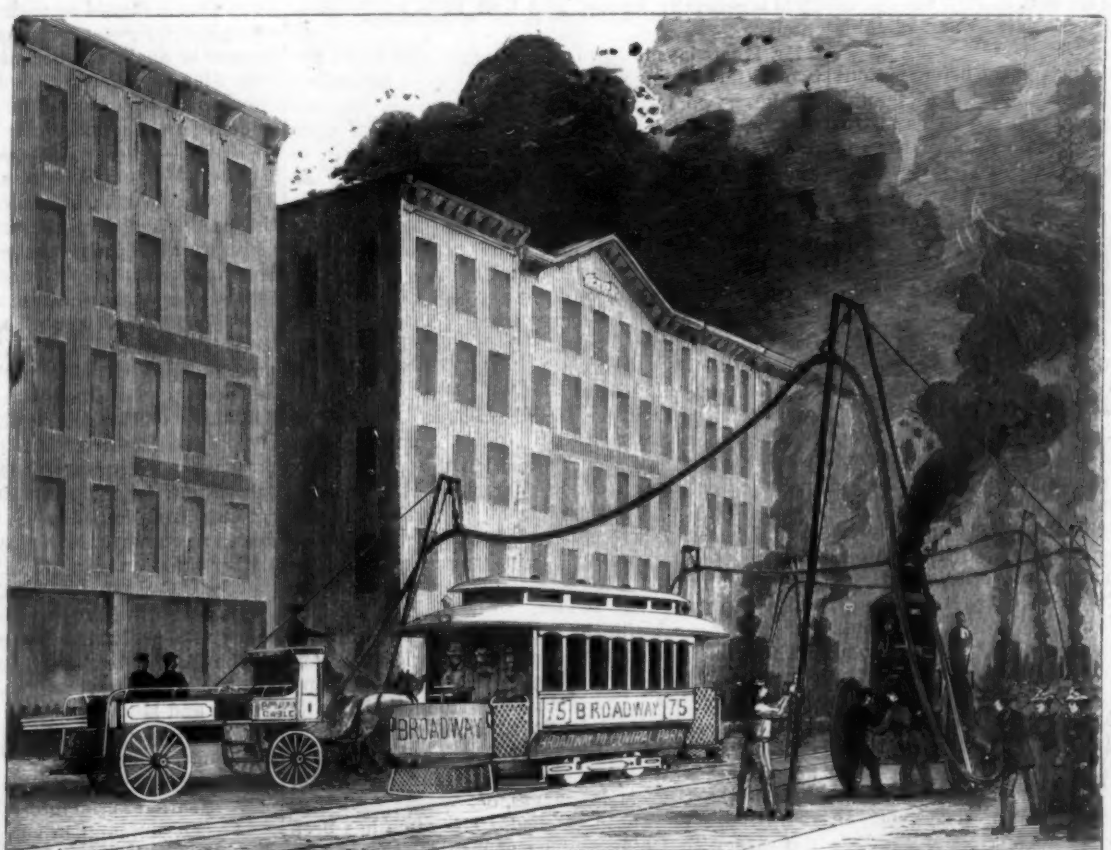
The Metropolitan Traction Company, owning the Broadway cable road in this city, has provided two patrol wagons for use in keeping its road clear of obstacles and for helping wrecked cars out of trouble, the operations of which are illustrated in this issue. The wagons, of which there are two, are stationed one at the corner of Broadway and Houston Street, the other at Broadway and 50th Street, where they are kept standing with the horses harnessed, ready for instant use at any moment of the day. During the night the horses are taken out and put in the stable, but the wagon is still ready for call at any hour.

The wagon has several lockers, in which are stored a varied assortment of tools, pinch bars, crowbars, cold chisels, slot bars, hammers, wrenches, and the like, really suggestive of a very complete burglar's kit. Besides these, several power jacks are stored away in the lockers, with one hydraulic jack. Underneath the wagon is suspended a sort of shoe like a small sledge runner made of heavy angle iron. This is used to place under the axle of a broken down wagon or cart which may impede the track, in order to enable it to be pulled away. Blocks and falls, several lengths of heavy wire rope, and similar apparatus complete the equipment.

The patrol wagon is subject to call for any of the numerous accidents which may happen on the line. Wagons or trucks may break down on the track, so as to prevent the cars from moving. A car itself may become disabled and have to be drawn off the track, and the grip may have to be removed. The patrol wagon is provided for all of these emergencies. Two or three men working with the jacks can in a very few minutes throw a car completely off the track, leaving the way clear for others. A broken grip can be taken out, a truck with broken axle can be removed to one side, and any similar work can be quickly performed.

The most characteristic service of the patrol wagons, however, is that which they perform at fires. Each wagon carries eight pair of shear legs, 20 feet high, with corresponding tackle, straps, and guys. On reaching the scene of a fire, the shear legs are set up on each side of the street, and guyed so as to lean slightly forward or toward the center of the street. Straps are put around the lines of hose which have to be carried across the street, the falls are attached, and the hose is hoisted as shown, leaving the way clear for the cars. It is obvious that owing to the grips no system of bridging the tracks is applicable to a cable road. The guys are fastened to any convenient place; the wagon carrying as part of its equipment steel pins to be driven into the ground, when no other efficient point of attachment for the guys can be found.

It yet remains to be explained how the wagon is summoned to the scene of trouble. The cable road is patrolled by a force of inspectors. Every few blocks along the line, close to the track, is a trap covering a signal station. From this station the inspector signals for the wagon in case it is required, calling it either up or down town. On receipt of the signal, the wagon proceeds up or down the line as ordered, the driver watching as he goes until he reaches the place where his services are needed.



THE PATROL WAGON OF THE METROPOLITAN TRACTION COMPANY AT A FIRE—HOW THE HOSE IS CARRIED ACROSS THE STREET.

Spontaneous Combustion of Colored Paper.

A correspondent of the London *Times* says: "One of my children complained that a smell of burnt paper was perceptible in the house. This smell had been noticed some hours previously, but was not then traced to its source. A careful search led to the discovery that a paper lamp shade in one of the rooms had been entirely consumed by fire. For two days prior to the accident, the lamp, a duplex, had not been lighted, and there had been no fire in the room. Since the morning of that day, when the room was dusted and the shade apparently in its usual condition, no one had entered the room. The shade was made about a year ago from so-called crinkled tissue paper, one white and one yellow sheet, gathered together on the upper part where it was fixed to the wire frame, where it formed a considerable bunch, and spreading thence over the frame below. On examination the yellow paper was found to be colored by chromate of lead, and this no doubt was the cause of the accident. There can, I think, be no doubt that this was a genuine case of spontaneous ignition, though I have not as yet been able experimentally to reproduce the necessary conditions leading to such a result. Fortunately there were no readily inflammable articles near, or a serious fire might have resulted, the origin of which would probably never even have been suspected. The dangerous paper is readily recognized by setting fire to a piece of it and blowing out the flame. In the case of ordinary paper it will be found that the glow along the burnt edge is very soon extinguished, whereas in the case of these chromate papers, it continues until the whole is consumed, as is the case with ordinary touch paper. I find that besides the yellow paper, pale green paper also contains chromate of lead, and would, no doubt, be equally dangerous, and possibly there are papers of other colors containing the same material. It would be interesting to learn whether any similar case has been observed before."

Gold Production.

Current statistics of the country's gold product in 1893 estimate it approximating $36,000,000—$3,000,000 more than 1892. The silver product for 1893 is estimated at a little over $78,000,000—a decrease of $6,000,000 from the previous year. The returns published in various papers lately show the yield of gold in Australasia for 1893 to be 1,876,561 ounces. Giving this a value of $20 an ounce would make that worth $37,531,240. It will be observed that Australasia produced more gold last year than the United States. For the first three months of 1894 the Witwatersrand district in South Africa has produced 467,056 ounces, an increase of nearly 50 per cent over last year. The South African gold, so reputed, is about 0·82 fine. If the African output is kept up during the year, the total will be about that of the United States for the same period. The average annual gold yield of the world for the last ten years has been $32,000,000.

So great is the echo in one of the rooms of the Pantheon that the striking together of the palms of the hands is said to make a noise equal to that of a 12-pound cannon.

The Telegraph and its Inventor.

On May 24 last occurred the fiftieth anniversary of the sending of that famous message, "What hath God wrought!" by the electric telegraph. A line had been constructed by government aid from Washington to Baltimore, and over this line that message was transmitted on May 24, 1844. This was considered the first practical demonstration of the invention. To estimate the value of this invention would be most difficult. It has bound the world together, made possible the daily press and the modern systems of business. Electricity in the industrial and commercial world dates from the above event. Since that day invention has followed invention, until it seems to the practical man of to-day that the summit has been reached; and yet possibly the same thought came to those who witnessed the sending of the first message.

Samuel F. B. Morse, the inventor of the telegraph, whose name is famous the world over, had the advantage of educated and wise parents, who directed his studies and whose counsels guided his conduct through life. He was educated at Yale College, graduating at 19 in 1810. His chosen profession was that of a painter. Under the best masters he studied in England, France and Italy. In 1813 his painting, "Dying Hercules," was placed among the twelve selected from those in the exhibit of the Royal Academy, London, and for a bust of Hercules he received a gold medal. This was his first success. His reputation grew rapidly and he executed many important commissions. A great disappointment, and one which even his later successes did not efface, was his failure to receive one of the commissions for the paintings for the capitol.

Inventors have come from nearly every walk of life, yet it is seldom that a person forsakes a calling in which he has attained prominence to enter upon the laborious duties of an inventor. Such, however, was the case with Morse. The field he entered was not unfamiliar to him. While at college he attended the lectures of Profs. Silliman and Day on electricity, and took great interest in the subject. In his studies and following the duties of his profession he added to his fund of general knowledge. He was a personal friend of Profs. Dana, Henry and others, who were experimenting with electricity. His inventive talent had previously manifested itself in many ways. Morse dates the invention of the telegraph from his voyage on the ship Sully, from Havre to New York, on his return in 1832 from Europe, where he had spent three years in executing numerous commissions and in study. It was suggested by conversation on the ship on the discoveries recently made in electricity. He spent almost the entire time during the voyage with his pencil, developing by means of drawings his system of telegraphy. The systems of telegraphy previously devised were limited to the distances the sight or hearing could cover, but his system was not limited by distances. Immediately upon his landing in New York he commenced the work of constructing his instruments. The history of the next ten years is similar to that of other inventors. Without the means to perfect and to place before the public in a desirable way his apparatus, he was obliged to make his own instruments and at the same time earn his expenses until he secured, in 1837, the aid of Mr. Alfred Vail, who became his partner and valuable assistant.

After having exhibited his instrument before various scientific societies and prominent citizens, he determined to place it before Congress. He set up his instruments in a room of the capitol and exhibited them to the President and members of Congress, but it was not until February, 1843, that he succeeded in securing an appropriation of $30,000 to test the capacity and usefulness of the system. The line from Washington to Baltimore was determined upon as likely to prove the most beneficial. The wires were to be placed underground, incased in lead tube, but after seven miles had been laid it was found that in the process of manufacture the insulation of the wire had in many places been destroyed. This plan was then abandoned and the wires were placed on poles. The work was prosecuted from both ends, and in May, 1844, the two parts were joined and the line completed. On the 24th the public trial took place. Two days later the national Democratic convention assembled in Baltimore, and the dispatches transmitted during the convention greatly increased the interest in the telegraph. All these dispatches were recorded on strips of paper, which was then considered an important part of the system.

For the operation of this line Congress appropriated $8,000 and placed it in charge of the Postmaster-General. Commencing April 1, 1845, a tariff of one cent for four characters was laid. For the first four days the revenue amounted to one cent; on the eighth day the revenue increased to $1.30. It was the intention of Morse and his associates to sell the patents to the government, and that the government would establish lines in connection with its postal system. In this he was not successful. In May, 1845, the Magnetic Telegraph Company was organized to build a line from New York to Washington, which was the first step in the establishment of the vast system that covers the civilized world. Prof. Morse received greater honors from the different nations than were paid to any American citizen. His life, which covered over fourscore years, closing in 1872, was full of activity.

Many interesting souvenirs of the telegraph and its inventor are preserved by his grandson and namesake, Mr. S. F. B. Morse, of Chicago, who is identified with the electrical industry. For a number of years he was connected with the telegraph, and at present is a member of a well known firm handling, in the West, insulated wires. Mr. Morse was a favorite of his grandfather, and retains a vivid recollection of many incidents and interviews with him.—*Electrical Industries.*

Compo-board, a New Building Material.

One of the factories that form the new huge plant of the C. A. Smith Lumber Company, at Forty-fourth Avenue North and Lyndale Avenue, Chicago, is a factory for the manufacture of what they call "compo-board." This material is designed to serve instead of lath and plaster, and is described as follows by the *Northwestern Lumberman:* It is made of ¼ inch strips of wood, from ¾ to 1¼ inches wide, placed between two sheets of heavy straw board and united under heavy pressure with a strong cement. The process of manufacture is peculiar. Into the machine that moulds the board are run two sheets of the straw board from rolls, one from above and one from below a table onto which are fed from a feeding device the strips of wood. A roller running in a tank of the liquid cement rolls upon the inner surface of the sheets of straw board, and the three layers of material run together between rolls and into a hydraulic press capable of exerting a pressure of 120 tons to the square inch. Ten feet of the board is stopped automatically for a few seconds in the press, then run out upon a table fitted with cut-off saws, where it is sawed to the desired length. It is then run upon trucks, placed in the dry kiln, and when taken out is trimmed to 48 inches in width.

The strength of the board as compared with its weight is marvelous. The ends of an 18 foot board can be brought together without breaking or warping it. No conditions can warp it. The new office building of the C. A. Smith Lumber Company is sheeted within with this material. Wall paper is put upon the board, and the finish is as fine as upon any plastered wall. The strong points claimed for the board are: It is not more expensive than first-class plastering. It forms an absolutely air-tight wall. It stiffens a building much more than any coat of mortar and lath can. It is quickly put on, and produces no dampness, thus causing no swelling and shrinking of floors and casings. It is light, thus avoiding the dragging down of the house frame, the consequent cracking of walls, and the warping of door frames. It forms a solider, cleaner, warmer, drier wall at no more expense than is involved in the old way.

The Chinese Language.

Mr. C. Imbault Huart, in a manual for the acquisition of the spoken Chinese language, analyzed by the *Revue Scientifique*, gives some very interesting information about this tongue, concerning which very little is generally known, and that little very inaccurately.

Mr. Huart lays it down as a principle that there are two distinct languages in China, or, more accurately speaking, two forms of the same language, the one written, the other spoken. The first consists of signs or characters of one or more strokes of the brush to each of which is conventionally attached a sound. As the keyboard of the human voice is limited, and as it was impossible for the cycle of Chinese knowledge to be so, it results that we find a host of characters that have identically the same sound, that is to say, that are pronounced alike, while at the same time having a particular sense. In consequence of this multiplicity of homophonous terms, this language cannot be spoken; it is only to be written. It has as its principal character *absolute monosyllabism.* The spoken language, on the contrary, is *polysyllabic.* Most of the words therein are formed of the aggregation of two or more sounds, to each of which, in the written language, corresponds a single character. It is spoken, but *not written.* This statement is worthy of meditation, and may be recommended to the consideration of those philologists who still insist upon classing the Chinese language as monosyllabic, and who perpetually confound the written with the spoken language—the signs with the words that they represent.

The principal character of every primitive language has been monosyllabism; there is no longer any doubt about that. Every language, monosyllabic in its infancy, has afterward developed by means of various processes, which, in the Indo-European languages, have been juxtaposition, attraction, composition, etc., and, in the Semitic languages, deflection; and thus polysyllabism has been reached. The same has been the case with Chinese. The spoken language, says Mr. Huart, had necessarily to originate before the written, and the Chinese characters were devised for figuring the idea that the sounds of the spoken language represented. But the list of sounds was quickly exhausted and it soon happened that such or such a sound was found to answer to several characters. The sounds were limited, but the figurative signs could not be. The Chinese then conceived of tones and aspirations, and this produced a certain number of new sounds; but this did not yet suffice, and they had to have recourse to another system. The sound *fou*, which, in the spoken language, expressed the idea of "father," "happiness," "housewife," "ax," "to hide," "to lift," etc., could indeed be varied by the aid of tones, but not by means of aspirations. The Chinese then invented a simple, regular and ingenious lexicological system. They formed words by the method of composition, that is to say, they combined the simple terms or the elementary roots of the language according to fixed rules.

Mr. Huart gives an example that clearly shows how the spoken language passed from monosyllabism to polysyllabism. The sound *fou*, above mentioned, having several meanings, would have inevitably led to confusion. Upon this sound being heard isolatedly, it could not have been known what *fou* it was a question of: whether it concerned *fou*, "father," *fou*, "wife," or *fou*, "to hide," etc. In order to avoid such ambiguity, the Chinese added to *fou*, "father," the word *ts'inn*, "relative," and *fou-ts'inn*, "father-relative," then signified "father;" to *fou*, "wife," was added *jenn*, "human being," and *fou-jenn* then signified "woman," "wife;" before *fou*, "to hide," was placed *mai*, "to inter," and *mai-fou* took the meaning of "to place one's self in ambush," etc.

Mr. Huart states that the Chinese language is easy to learn. Its grammar is simple, and free from all those stumbling blocks that arrest the progress of students of the European languages. In Chinese there is no article, no gender, no declension and no conjugation. The relations of substantives, tenses and moods are marked by particles, which are very few in number. In itself, the syntax is quite simple, and has the logical order for its basis. The rules are few and easy to remember.

The Chinese themselves, even the most highly educated, have no knowledge of the grammar of their language. They do not know what a noun in the genitive, dative, instrumental or ablative is, nor what a substantive, adjective or verb is. They divide the words of their language into two great classes—the "full" and the "empty" words. The former are those that have a proper signification, such as nouns, and the latter are particles that serve merely for modifying the meaning of the former or for marking the relations that connect them. Their language once created, the Chinese have not known how to derive rules therefrom. The idiom has become fixed by *usage*—a word under the protection of which everything is placed in China. The most learned member of the "Forest of Pencils" (Institute of China) would be incapable of analyzing the first sentence presented to him or of explaining it grammatically. If he were asked why the sentence was constructed in such a manner rather than in another, or why such a word was found at the beginning and not at the end, he would never be able to tell. He would answer that he knew that it *should* be so, but that he did not know *why.* The Europeans and Americans are the only ones capable of analyzing a sentence, and they alone have been able to deduce rules of grammar and syntax in order to guide students and teach them to learn how to construct correct Chinese sentences.

Artificial Production of Citric Acid.

Mr. C. Wehmer, in carrying on experiments upon the production of oxalic acid by fungi, has found a genus (to which he gives the name of *Citromyces*) that has the remarkable power of converting carbohydrates into citric acid. Of the genus, he describes two species, *C. Pfefferianus* and *C. glaber.* Their ordinary mode of multiplication is by conids, but they occasionally produce other structures, which may be sclerotes or asci; and a yeast-like budding also occurs. The production of citric acid is in the first place due to oxidation of the carbohydrate, and is dependent on the presence of oxygen. The most favorable nutrient substratum for its formation is a moderately concentrated solution of sugar. The change is probably due to a process of oxidation represented by the following equation:

$$C_6H_{12}O_6 + 3O = C_6H_8O_7 + 2H_2O.$$

A full description of the conditions under which it takes place is given in a paper that was communicated to the Berlin Academy of Sciences last June. This mode of producing citric acid is now being worked at Thann and Mulhausen, and there is a prospect that, in addition to its scientific interest, it will be of industrial importance.

In connection with this subject, the *Kew Bulletin* calls attention to the interesting coincidence that citric acid has been found in sugar cane juice, and that it sometimes makes its appearance during the process of sugar manufacture.

THERE are 10,000 copyrighted volumes of American poetry in the Congressional Library at Washington.

Correspondence.

How to Mend an Incandescent Lamp.

To the Editor of the Scientific American:

T. R. E., in query 5978, date April 28, 1894, asks how to mend an incandescent lamp when the wires are blown off close to the glass. I mended a small lamp of the Swan type by filing off the glass (with an ordinary steel file) close to the broken wire, making a right-angled cut, then carefully bending the projecting piece of platinum wire into a small hook; round this I lashed some thin platinum wire, so as to form a loop to take the place of the broken one. These loops can be easily fitted in the two bent wires in the holder, taking the precaution of pressing back the spring wire when inserting the lamp. I advise T. R. E. to buy lamps in which the glass neck is surrounded by a metallic ring, the space filled with some insulating material, out of which two strong copper wires, soldered to the platinum wire, project. These wires are twisted several times into a loop. This kind of lamp, as I know from experience, can stand almost any kind of rought treatment.

F. HAUSHAHN.

Propaganda, Rome, Italy.

Artificial Perfumes.

Almost all the natural perfumes are of vegetable origin, and are derived from the treatment of flowers and fruits. In this way are obtained the aromatic essential oils of rose, mint, anise, santal, thyme, cloves, etc., and the perfumes of the violet, iris, and jasmin. Musk is the only important perfume that is of animal origin.

For a long time now, the odor of fruits has been imitated with the aldehydes and ethers of fatty acids, such as the acetates, valerianates, benzoates, salicylates and butyrates of methyl, ethyl and amyl, which, mixed in definite proportions, recall the odor of strawberries, raspberries, apples, pears, etc. The following are two examples of such mixtures:

PERFUME OF THE PINEAPPLE.

Chloroform	10	grammes.
Aldehyde	10	"
Butyrate of ethyl	50	"
" of amyl	100	"
Glycerine	30	"
Alcohol, 100°	1	liter.

PERFUME OF THE APPLE.

Chloroform	10	grammes.
Nitric ether	10	"
Aldehyde	20	"
Acetate of ethyl	10	"
Valerianate of amyl	100	"
Glycerine	40	"
Alcohol, 100°	1	liter.

The aroma of rum and cognac and the bouquet of wines have also been reproduced artificially. We shall not dwell upon the danger that accompanies the use of these products in a large quantity when they are mixed with beverages and alimentary substances. We shall occupy ourselves here more particularly either with products like those that we find in nature, such as vanilline, or with perfumes such as musk and the odor of violet, which are designed not for alimentation, but for perfumery properly so called.

Among the aromatic products employed as perfumes we may first mention methylsalicylic ether, which reproduces the oil of wintergreen (*Gaultheria procumbens*). The oil of bitter almonds, too, has been frequently replaced by nitrobenzine, which is prepared in large quantities by manufactories of coloring materials. Nitrobenzine, as regards composition, is absolutely different from the oil of bitter almonds, but it resembles it in odor. Benzaldehyde, likewise, has replaced the oil of bitter almonds in certain cases.

Such substances possess but a secondary importance; but vanilline, on the contrary, which reproduces the odoriferous principle of the vanilla bean, is the object of an extensive and very prosperous manufacture. The first process that gave rise to it was elaborated in 1874 by Messrs. Tiemann and Haarmaan. In studying coniferine, these scientists found that it was formed of a glucoside which, under the influence of a special ferment (emulsine), split up into glucose and coniferic acid. This latter, through oxidation, gives vanilline. The coniferine itself, oxidized with a mixture of sulphuric acid and bichromate, furnishes vanilline. It was by this process that it was first manufactured. The method of purification was very simple. Like aldehyde, vanilla possesses the property of forming an insoluble bisulphite combination, which was separated from the mass and afterward decomposed.

Chemically, vanilline is methylprotocatechic aldehyde:

$$C^6H^3\begin{array}{l} /CHO \quad (1) \\ -OCH^3 \quad (3) \\ \backslash OH \quad (4) \end{array}$$

The figures to the right of the atomic groupings represent the relative positions in the benzenic nucleus. They are of considerable importance, since isovanilline, which is constituted by exactly the same groupings, but differently placed, has no odor. After the formula of vanilline became known, an endeavor was made to employ the neighboring bodies, to add the groupings that were wanting, and to properly place them with respect to each other. A host of methods was proposed to this effect, in making use of eugenol (De Laire and Tiemann), which was oxidized by permanganate; of eugenol and bromide of methylene (De Boissieu); and of guaicol and pyrocatechine (Tiemann and Reimer). Vanilline is even found in certain natural products, such as the benzoin of Siam, crude beet sugar, asafœtida, and opium. A certain number of these processes is employed industrially.

Piperonal or heliotropine is closely connected with vanilline. It is, in fact, the methylenic ether of protocatechic aldehyde. In order to prepare it, piperic acid is oxidized by permanganate, but it can also be obtained by means of safrol. It is found in the oils of sassafras and shikimal, and can also be obtained from the oil of camphor. Coumarine is the anhydride of ortho-oxycinnamic acid. It has been obtained synthetically by Perkin by causing acetic anhydride to react upon the sodium salt of salicylic aldehyde. It is especially extracted from natural products, such as the Tonka bean and the "vanilla plant" (*Liatris odoratissima*) of the United States.

Spirit of turpentine has likewise yielded a perfume, the terpineol of De Laire. To this effect, one can either dehydrate terpine or treat spirit of turpentine directly. This perfume is known under the name of lily of the valley or lilac.

We now come to the two most recent discoveries, viz., the perfume of musk and that of the violet. Natural musk is the product of a secretion of the musk deer, a ruminant mammal that inhabits certain regions of Asia. The perfume is found in a sac which usually contains from 14 to 20 grammes of it. It is also found, but in much smaller or even minimum quantity, in other animals, such as the civet, the musk rat, the badger, and the marten. Certain plants, too, often possess the odor of musk. This product is of the highest importance, since it is the base of all artificial perfumes, which sometimes contain considerable quantities of it.

The first process of preparation of a product having the odor of musk was discovered by Messrs. Schaafer and Haffeld, who heated a mixture of dimethyl-benzine, isobutylic alcohol, and chloride of zinc, which they afterward broke up and nitrated. The truly industrial discovery of an artificial musk dates back to 1889, and was made by Mr. Baur, on the occasion of some researches upon the oil of resin.

In order to prepare the Baur musk, chloride of isobutyl is made to react upon toluene (methyl-benzine) in the presence of chloride of aluminum. We thus obtain isobutyl-toluene, which, under the influence of nitric acid, is converted into trinitroisobutyl-toluene, which is the somewhat cumbersome chemical name of commercial musk.

There exists, theoretically, a host of analogues and homologues of this musk. A certain number of them have been prepared from xylene, cymene, and the diphenyl and xylyl methanes. A large number of such products possess the characteristic odor of musk.

A no less important discovery is that made a year ago by Mr. Tiemann, who reproduced synthetically the perfume of the violet (called ionone), after a series of researches of the greatest interest, from a scientific standpoint.

In order to prepare this perfume, we start from citral, which is itself derived from the oil of lemon, or from the oxidation of the alcohols of the formula $C_{10}H_{18}O$ that we find in certain essential oils: geraniol, linaleol, aurantiol, and lavendol. The citral is shaken with acetone and barytes, and pseudo-ionone is thus formed. This body is odorless, and in order to render it odorous it is necessary to convert it into ionone, a product which is very closely related, but which is cyclic, while the pseudo-derivative is of the open chain series. A long series of similar products can be made with other acetones, and these have been studied with the greatest care by Messrs. De Laire and Tiemann.

Messrs. Tiemann and Kruger, on treating orris root with appropriate solutions, have separated various products, and, among others, irone, which is the odorous principle of this root, and it was in the wake of these experiments that the synthesis of ionone was made, these two bodies being, in fact, isomerous, and consequently very closely related.—*Le Genie Civil.*

Electrically Driven Cotton Mills.

The Ponemah mills are located at Taftville, Conn., not far from Norwich. An electrical apparatus has lately been installed by the General Electric Company for driving Ponemah machinery. The motive power is furnished by water wheels located at Baltic, on the Shetucket River, which is 4½ miles from Taftville. At this point a dam 625 feet long has been thrown across the river, which furnishes motive power with a head of 32 feet for turbines that yield 1,500 horse power. Here the dynamo machines are located. The wires leading from Baltic to Taftville are No. 0 bare copper, four in number, supported on standard oil insulators. The efficiency of the complete transmission at full load from the power applied to the dynamo pulley to that delivered to the motor pulley is 80 per cent. There are 1,700 looms in the new mill, which is lighted by electricity.

How Gas Companies Swindle the Public.

Among the papers read before the Western Gas Association at its recent meeting in Cleveland was one by Mr. Wilkiemyer upon "The Best Method of Introducing Gas Stoves." In the discussion which followed Mr. Evans told how his company worked the subject as follows:

We adopted rather a novel method of introducing gas stoves, by distributing circulars to every family on the line of our street mains, offering to give them a gas range free. Of course the object of this circular was to bring possible consumers to the office, where we could explain what we meant by it. Of course we had a "string" to the offer. Our explanation was simply this: If the consumer would pay for $20 worth of gas in advance we would give him a $25 gas range, or, rather, a gas range he could not purchase for less than $25 at retail. Of course they could not understand such an offer. Our explanation was that by the use of $20 worth of gas, having acquired the knowledge of how to use gas properly, they would become permanent consumers. Of course the facts were simply these: They paid for the gas in advance; we had the money to buy the stoves with; we made a profit on that $20 worth of gas sold which was nearly enough to pay for the stove (laughter); and we got a permanent consumer. Perhaps I will modify that a little by saying that it does not cost any more to distribute 200,000 feet of gas than it does to distribute 100,000 cubic feet. In figuring on the cost of gas, in that deal especially, we figured on the cost of the gas in the holder; and our profits accrued on the margin beyond that. As a matter of fact it did bring us in immediate business. On that plan we put out 1,500 gas ranges within three months; and those gas ranges brought us in a consumption of 150,000 feet per day; and as a matter of fact we made $9.40 per thousand profit (laughter)—I mean $9.40 profit on each $20 worth of gas sold; and between that and what the gas ranges cost us was certainly an advertisement that paid us to adopt that system.

The President—The idea is a good one, and I think it has been tried by some others, though not perhaps in exactly the same way.

A Letter from William Penn.

The *Leisure Hour* says: The spade of Mr. J. J. Cartwright, F.S.A., has been busy among Lord Lonsdale's muniments at Lowther Castle, and has dug up some literary treasures of decided historic value. One is a letter in which William Penn describes Pennsylvania. It is written to Sir John Lowther at Whitehaven, and dated in the orthodox Quaker fashion:

"16·6m, 1701, Pennsberry.

"Honored Friend, I would not but have thought my selfe lost in thy country entertainments but I finde that Whitehaven is much kinder than Whitehall to Pennsylvania, for the one sends its good wishes and the other suffers itselfe to be mislead to crush such prosperous beginings. I return my most hearty acknowledgements for thy obligeing remembrance and beg the continuance of thy good word and wishes for our prosperity; for whatever interested men suggest, we are an approved experiment what sobriety and industry can do in a wilderness against heats, colds, wants and dangers. The Crown gets best by us, but its officers less than by other Governments, and that's our crime; but time will sett truth in a better light, to which I adjourn my resentments. We thrive, our town, I think, too much for the country, not keeping a ballance in all things in Government is (perhaps) the hidden but sure cause of visible obstructions and entanglements in administration. I finde the country 70 miles back, the best land, Sasquehanah a glorious river boatable upon freshes. We are planted 170 miles upon Delaware, and in some places 16 miles back into the woods. Our staple corn and tobacco; we are trying for rice, converted timber for shipping and hemp. Returns for England is what we want, and either we must have less from thence or better ways of making them. Barbado's and those Islands are our market and we are too hard for our neighbours for our flowr and bread, being the whitest and preferred; we spare much of both to our neighbour colonys also, as New England, Maryland, Virginia, and Carolina, where wheat will hardly grow, but rice to perfection, and silk is got to a good pitch, and will certainly be a commodity. We have had a good share of health since our arrival and my family increast by a little son, and if ill treatment call us not home are like, if God please to prolong life, to pass away a year or two at least. Only my privat affairs could make me leave it any more, but they will compel it once again, and then it would not displease me to lay my bones where I have layd my labour, mony, and solicitation, in Pennsylvania.

"I shall close with this assurance that I am with great esteem and affection

"thy very faithfull Friend

"WM. PENN."

FLOWER AND FEATHER MANUFACTURING.

The great number of artificial flowers used in trimming ladies' hats and for other ornamentation are made mostly of muslin, linen, velvet, satin, and silk. The material if for white flowers is first fastened on to stretchers in sheets and their backs coated with a solution composed of dextrine and starch. This solution stiffens the material so that it can be worked and formed into shape. After drying it is ready for cutting. For colored flowers the material is dyed. About five gallons of aniline dyeing solution is mixed up into copper boilers and heated by steam; the material is then placed into it and dyed in a few minutes. They are then run through a wringer and placed upon stretchers to dry and have their backs sized. The sheets when dry are then taken to the cutter. About a dozen at a time are placed over an oval-topped leaden block, the operator beginning at one corner, cutting out the flowers one after another until the whole sheet is used up. The cutters are made of steel the size and shape of flowers, among which are the buttercup, daisy, rose, etc. The cutters are about one-half inch in depth, so that when the operator strikes with the hammer, the tool passes down through the material, cutting out about one dozen flowers at once. An operator can cut out about 2,000 flowers per day.

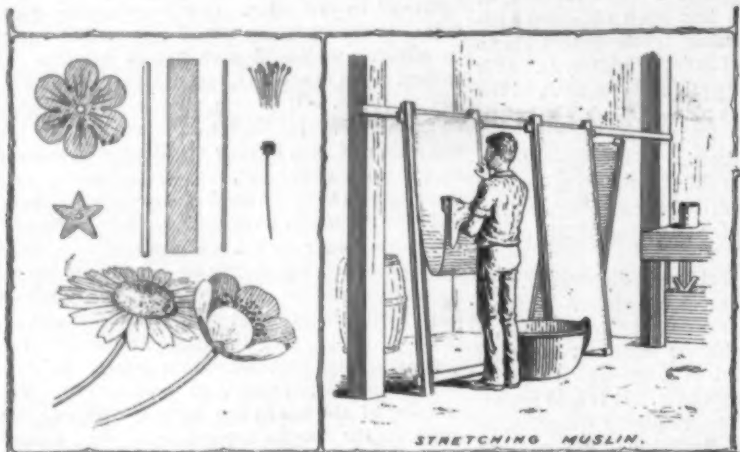
The flowers are then taken and veined. The veiner consists of two dies the shape and size of flowers, one being made to fit inside of the other. The bottom of each die is veined, one being raised and the other sunk. The flower is first placed into the bottom die; the attendant then places the top veiner, which fits exactly into the other, over the flower, and places both under the press. The attendant, by turning the wheel of the press, forces the top veiner down into the other, the pressure of which forms the veins into the flower. A good hand can vein about three gross of flowers per hour. Flowers that are more or less cup-shaped go through what is called the gofering process. The flowers after being veined are placed on a cushion or pad. The operator heats the gofer, which is a circular steel ball attached to the end of an iron rod, over a lamp; when it is properly heated, the gofer is waxed and the operator presses and works it round the center of the flower, the pressure and heat of which causes the flower to curl up into a circular or cup-shaped form.

The flower is then put together, the parts of which are composed of muslin, velvet, etc., wire, jute, tissue paper, muslin tubing, wool and corn meal. The first operation, if forming a buttercup, is fastening the center piece and the stamens to the wire stem; the center piece is made of corn meal fastened to a coarse thread by means of rubber gum. This in turn is gummed to the wire stem. The stamens, which are made of jute, are then placed around the center piece and stem and the whole carefully wrapped around with tissue paper. The stem is then run through the bottom of the flower and into the muslin tubing, the parts being thoroughly gummed together. The daisy centers are made mostly of wool dyed.

By moistening a quantity of white flowers in alcohol and water and placing them separately on to wooden frames they can be colored by the point of a brush, the alcohol solution making them take the aniline color. The feathers and birds, which are also used for trimming purposes, come from all parts of the world. There are over four or five hundred different varieties. The natives shoot them with guns or kill them with blowpipes. The entrails are taken out by them, and the skin and feathers stuffed with wild cotton. The birds and feathers are preserved from moths and vermin by sprinkling them with the ashes of burned wasp nests. The natives sell the birds for about two cents each. Great numbers of turkey, goose, and chicken feathers are used. The feathers that are to be dyed are first fastened at the quill end to a string and put into a dyeing boiler. After dyeing they are put through a wringer. From the wringer they are beaten dry by an operator holding the ends of the string in his hands and striking them down on a paper-covered table. This operation causes them to dry in about ten to fifteen minutes. After drying they are taken to the steaming apparatus.

The steamer is oval-shaped and made of copper; it is about three and one-half feet in length, about fourteen inches in height, and about twelve inches in width. Projecting from the top are a number of conical shaped tubes through which the dry steam issues. The attendants hold the dried feathers into the steam for a few moments, which moistens them slightly, and then by running the fingers along the barbs toward the top of the feather causes them to straighten out and become smooth. The edges are then trimmed and either frosted or covered with jet. A great many of the colored frostings are made of gelatine. Gold metallic, copper, and silver are also used, the material being fastened on by means of rubber gum. Ostrich feathers are dyed and beaten dry in the same manner as the common feathers. After beating they are pared or scraped down to give greater flexibility.

The barbs are curled by drawing them singly over the face of a blunt knife or the cautious application of a heated iron. The best feathers come from the male bird, those coming from the wings and rump being white, and the short feathers jet black. In the female the feathers are tinged with a dull gray. Dull-colored feathers are usually dyed black with logwood and sulphate or acetate of iron. There are as many as 1,000,000 birds imported into this country yearly. The sketches were taken from the plant of L. R. Alexander, West Hoboken, N. J. When running full with about 60 hands, they turn out $20,000 to $30,000 worth yearly.




THE ARTIFICIAL FLOWER AND FEATHER INDUSTRY.

A Practical Turn of Mind.

The *Medical Record* tells of a woman in Ohio who utilized the high temperature of her phthisical husband for eight weeks before his death, by using him as an incubator for hens' eggs. She took a number of eggs, and wrapping each one in cotton batting, laid them alongside the body of her husband in the bed, he being unable to resist or move a limb. Fifty was the number of eggs first used as an experiment, and after three weeks she was rewarded with forty-six lively young chickens. The happy result of the first trial prompted her to try it again, and this time she doubled the quantity, and was again rewarded for her ingenuity with another brood of chickens. Another hundred eggs were placed in the bed, but this time her husband was so near the end that the necessary heat was lacking, and he passed away, leaving behind one hundred half-hatched chicks. The scheming wife, not to be outdone in her plans by grim death, placed the eggs in the oven, thinking to finish the work her husband had failed to complete. During the bustle and excitement of the funeral, however, she allowed the fire to get too hot, and the eggs were all cooked.

The editor says he hopes there is no incubator awaiting this woman in this world, at least!

THE deepest boring is that of Schadebach, in Prussia, 5,736 feet deep—a little over one mile.

THE CALIFORNIA MIDWINTER EXHIBITION.

(*Continued from first page.*)

equipment of stage coach, "road agents," keno layout, etc. All these could be found and many more, but of these diversions we have no concern.

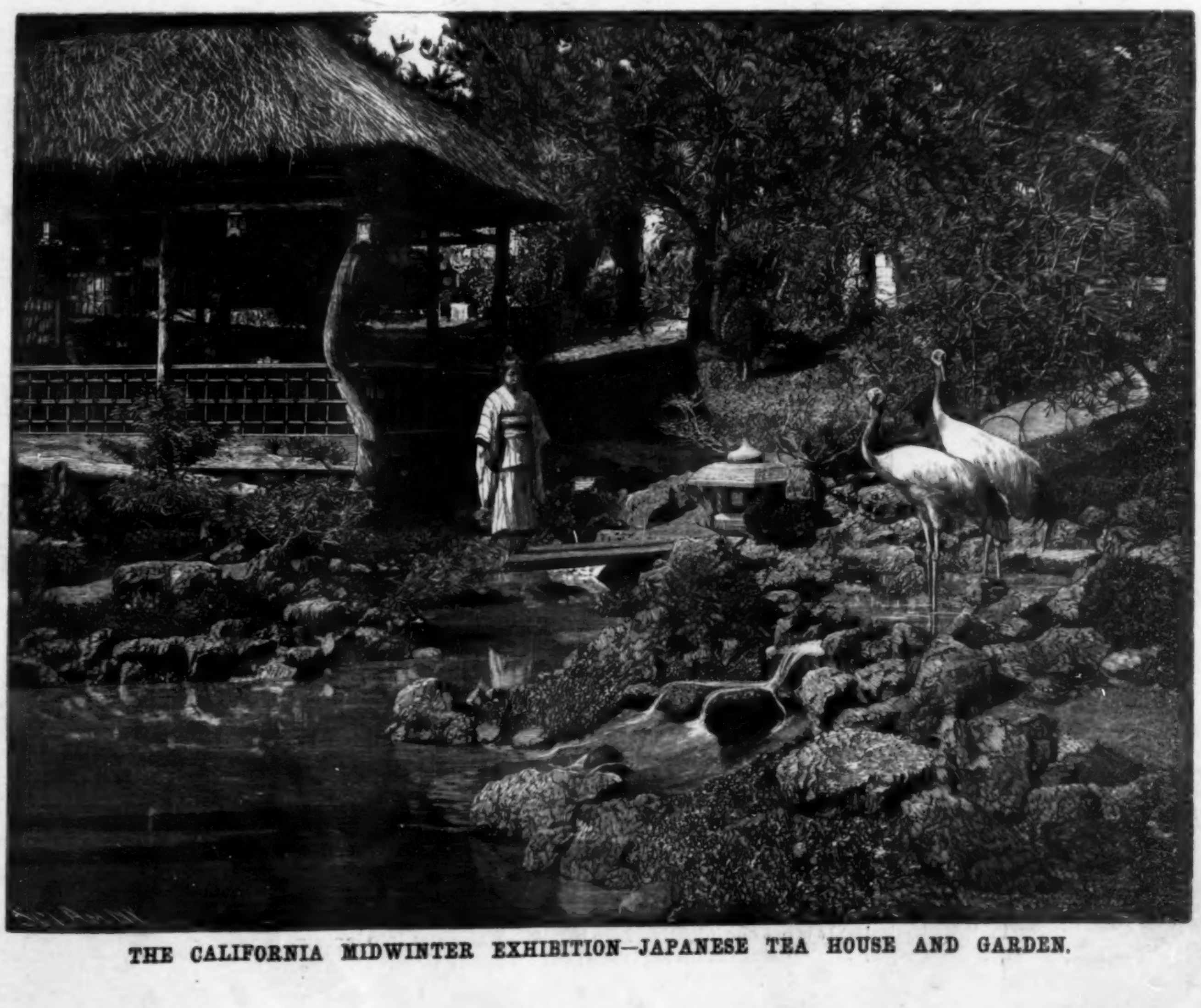
In the middle of the Great Court of Honor of the Midwinter Fair stands the Bonet electric tower. Owing to its height of 272 feet, and its central position, it will readily be seen that the tower is one of the main features of the Exposition. The tower is built throughout of steel and was erected by Leo Bonet & Company, architects. To make the foundations, piles were driven in 17 feet and over 30 tons of cement were used. The Belvista Café is situated on the first platform, at an elevation of 80 feet above the level of the ground. It forms a delightful feature of the Fair for visitors to be able to lunch and dine at such a height apparently suspended in mid-air, and a delightful view of the grounds and surrounding country may be obtained from it. The second platform is 146 feet high, and the third is 220 feet high. On the fourth platform is placed one of the largest searchlights ever constructed.

THE CALIFORNIA MIDWINTER EXHIBITION—INTERIOR OF THE JAPANESE TEA HOUSE.

Access to the various platforms is gained by the use of an electric elevator constructed by the Otis Company. This elevator was removed from the Manufactures building at the Chicago Fair, and was illustrated in the issue of the SCIENTIFIC AMERICAN for October 28, 1893. The elevator runs up to the third platform, which is ten feet wide, and affords an excellent opportunity to study the arrangement of the Fair grounds. At night the Exposition is superb, and some idea of the brilliancy of the scene may be obtained when it is stated that on the tower there are 3,213 incandescent lamps, which by an interrupter are constantly "blinking" or forming patterns of various colors. The grounds are brilliantly illuminated and the outlines of the buildings are picked out in lines of light by the use of incandescent lamps. It is somewhat difficult to appreciate the height of the cafe, owing to the structure that appears in front of it. This represents an elevated path ending in a spiral inclined plane. The wonderful extent to which the sense of equilibrium can be developed is demonstrated by the performance which is represented in progress. The performer causes the ball to travel along the path, ascend and descend the spiral, and finally brings it and himself in safety to the platform below by the mere effort of balance.

The colossal statue of Columbus, one of the special features of the Fair, appears quite near the tower. Our engraving was prepared from a photograph kindly furnished us by Mr. A. W. Cornwall.

The bizarre style of architecture which has been used in Japan from time immemorial always suggests something mysterious, and hints at heathen rites even when the buildings are transplanted to our more rigorous country. Although Japanese villages have been from time to time exhibited in the United States, still the true Oriental effect was lost on account of incongruous surroundings. At the Columbian Exposition, the Tea Garden and the Hoo-den or the Japanese phenix palace were objects of great interest, and were enjoyed by many visitors, but when the Midwinter Fair was proposed, it was soon seen that many Oriental effects could be obtained without the necessity of a miracle of the landscape gardener's art. The surroundings of the Tea Garden at the Midwinter Fair are most appropriate. Gorgeous flowers, fine trees and shrubs, and a miniature lake furnished unbounded possibilities to the promoters of the enterprise. In this ideal garden were erected a number of grass-thatched buildings. In the foreground will be noticed the dwarf trees, the raising of which is quite an industry in Japan, and one in which the Japanese excel. The storks are tame, and they have acquired bad habits in America, as they are very prone to loot the pocket of the visitor. The Japanese regard the birds as sacred, and hold them in veneration. Our other illustration shows the orchestra in the tea house. A Japanese female dancer is just ready to perform one of the graceful little dances which are so celebrated. Looking at this dainty little creature, it is no wonder that Pierre Loti says: "The mysterious little cabinet curiosity, the Japanese woman." The minute scale on which every thing is constructed makes the visitor feel truly Brobdingnagian. The household utensils are like children's toys. Even the pipes which the animated figurines are perpetually smoking are infantile, being no larger than an acorn cup. They look with surprise at a foreigner with his large-bowled pipe, and they have a saying, "At the bottom of a pipe there lives poison." Some of



THE CALIFORNIA MIDWINTER EXHIBITION—JAPANESE TEA HOUSE AND GARDEN.

the mysterious little cupboards and closets which form such a distinctive feature in Japanese houses are shown in our engraving. It is strange that some one has not reproduced a Japanese house for a summer villa, for the construction would not be costly, the furniture must be simple to harmonize and there are wonderful artistic possibilities. The tea is presented in the tiny cups with a politeness which casts a shade upon the Frenchman.

The Japanese Tea Garden is an interesting feature of the Midwinter Fair, and rarely have both nature and art been blended with such satisfactory results. Our illustrations are made from photographs taken by Mr. A. A. Martin.

Earth, Sea and Sky Advertisements.

Lord Rosebery made a speech at the Royal Academy dinner lately, and the *Lancet* says the most amusing portion of it was on the various advertisements now occupying earth, air, and water, which have become common also on this side of the Atlantic. It is not altogether that the landscape is affected by hideous boards, which, by spoiling its beauty, influence injuriously the good taste of the traveler; it is the effect of the reading of those boards on the health both of mind and body against which we too would raise a protest. When a person leaves his home to travel through the country, whether on business or pleasure, there is always, in properly conducted journeys, some benefit derivable from the charm and picturesque character of the landscape that comes before him. He forgets himself, his worries, his troubles, his pains, in the diverting objects he sees. There is the church forming the center of the pretty village, calling up memories and suggestions which fill the mind with thoughts of the past and hopes of the future. There are the distant blue hill, the green meadow, the copse, the wood, the cottage, the castle, the park, the mansion; and connected with these there is always some bit of romance gathered from past readings and meditations which comes as a relief, a dream outside the busy world, changing the monotony of life, and by the very forgetfulness of past troubles giving a repose in variety which has the effect of cure in some instances, of relief in all. But what shall be said when from place to place the mind of the traveling sufferer is, *nolens volens*, forced to dwell on his own ailments, real or imaginary? Why is he obliged to learn that he has a liver that is not in working order; or that his digestion is, day by day, failing; or that he is getting every hour weaker and weaker; or that his heart is palpitating; or that his kidneys are involved in the universal break-up of his frame; or that his brain is altogether losing its balance; or that he is becoming prematurely old; or that, in short, he must soon die if he neglects to treat himself with some particular life-giving pill, potion, lotion or plaster, to say nothing of two or three ointments which have the facility of going direct to the bone? Lord Rosebery's humor ought not to be misapplied. There is many a true word spoken in jest, and, emphatically, his words were true. We hope he will not stop here, but that, holding the reins of power, he will go beyond the misfortunes of the Royal Academy and, pitying the misfortunes of the public generally, will suggest such legal measures as shall clear earth, water, and sky of these irritating abominations.

Matter—Solid and Liquid.

In the course of the last of his lectures on this subject at the Royal Institution, Professor Dewar dealt with what he said might be called the elastic problem—the relations of force or stress to the corresponding alterations produced by them in matter. At the outset he remarked that the determination of the constants of solids was more difficult than it was in the case of liquids, on account of the smaller changes in volume that took place. In the case of a solid there were three constants to be found—its extensibility, its torsional variation at different temperatures and pressures, and its general compressibility. The extensibility of a metal was expressed by Hooke's law that elongation was proportional to the force producing it, while the alteration which occurred simultaneously in cross section was given by "Young's modulus." Some idea might be gained of the resistance of any material to compression or tensional strain by investigating the force necessary to break it at various temperatures. Non-crystalline metals at low temperatures would bear a much greater strain than at ordinary ones. It was experimentally shown that a rod of tin which at ordinary temperatures had a breaking strain of 200 pounds required at 180 degrees below zero a strain of about 380 pounds to break it. In the same way iron and lead at low temperatures would bear twice as much strain without breaking as they would at ordinary temperatures. The determination of the breaking strain of mercury was also shown. The mercury was first frozen in a tube. The resulting solid rod was then immersed in liquid oxygen and tested in the usual way, when it was found to break with a force of 31 pounds to the square inch. Some other experiments were also made to show the changes in the physical constants of metals at low temperatures. Two equal rods of the same material were supported at their ends and one of them was cooled to —180 degrees, the other being at the temperature of the room. A weight which at once bent the warmer one had no effect on the other. Two tuning forks which sounded in unison became decidedly dissonant when one of them was cooled to —180 degrees, a fact which shows that the period of vibration had been altered by the change in rigidity. Professor Dewar concluded from his experiments generally that the resistance of metals to strain increased as the temperature was lowered, and he supposed that at —273 degrees, the zero of absolute temperature, all metals would be infinitely resistant.

Simple Process of Bronzing.

The very pretty artistic effects that are obtained from galvanic bronzing cause this process to be highly esteemed by manufacturers; but it requires apparatus that one does not always have at hand. Mr. Mandit, of Caen, says *Le Genie Civil*, has recently made known a very simple formula, which is capable of giving every tone, from that of Barbedian bronze to antique green, according to the length of time that the copper is allowed to remain in contact with the liquid. Its very simplicity will cause it to be appreciated by those interested.

After the piece has been well scoured it is covered with the following mixture by means of a brush:

Castor oil	20 parts.
Alcohol	80 "
Soft soap	40 "
Water	40 "

The piece, left to itself for twenty-four hours, becomes bronzed, and if the duration of the contact be prolonged, the tone changes. An infinite number of tones, pleasing to the eye, may thus be obtained. The drying is finally effected with hot sawdust, and it then only remains to coat the piece with a colorless varnish, greatly diluted with alcohol, in order to obtain an eminently satisfactory result.

On the Origin of Death.

The most remarkable phenomenon of life is death. To the superficial observer it may appear a matter of course that every living thing, the smallest speck of protoplasm as well as the most complicated organism, should bear the germ of death within itself, but to the more penetrating vision death presents itself as an insoluble mystery. From time immemorial the subject has been made the battle ground of metaphysical discussion; but the question of its origin, of its biological significance, of its physiological explanation, has only in quite recent years become the subject of rigorous scientific discussion.

Investigation into the duration of life constitutes the first link in the chain of Weismann's achievements in this direction of research. "Organic bodies are perishable; while life, with a show of immortality, passes from one individual to another, the individual himself dies." So said Johannes Muller, and Weismann characterized the expression as significant, and exhaustive of all that can be said on the subject.

Be that as it may, so much at least is beyond doubt, that the life of the individual, in so far as concerns the experience of non-scientific observers, has its natural limitations. It is equally beyond question that these limitations vary with different species of plants and animals. The physiological constitution of the plant or animal has been supposed to determine the duration of life, but however much it may condition that duration, it is certainly not the only factor. In the last analysis the determining cause must be sought in the organism itself. The moment we endeavor to base the duration of life upon size or complexity or physiological constitution we realize that the theory is irreconcilable with the very divergent facts. The elephant lives to 200 years, but so also do the carp and pike; the horse may live to 40 years, but so also do the toad, the cat, and the sea anemone. How indeed could we reconcile with this theory the fact that working ants live for years, while the males live only a few weeks? The physiological conditions are most assuredly not the sole factors.

This brings us to the fundamental idea of Weismann's theory. According to him, external conditions operating by natural selection are the prime factors in determining the duration of life. It will be evident to every one familiar with the operation of natural selection that the aim to be achieved is the perpetuation of the species and not of the individual. The individual needs no greater capacity of persistence than is necessary to the propagation of the species, and this being provided for, we might reasonably assume that the individual, having performed its chief life labor, would immediately die, unless the care of the young is necessary to the maintenance of the species. And this indeed is the fact. All mammals and birds survive the completion of their reproductive functions, while insects, with the exception of those which care for their young, die on completion of their task.

It is not our intention here to follow Weismann into all the details of his argument; but his line of thought takes us directly to one of the most difficult problems of physiology—the cause of death. Death, in the last analysis, is an adaptation. "I do not believe," says Weismann, "that the duration of life is prescribed because its nature is inconsistent with unlimited duration, but because an unlimited duration of the (no longer procreative) individual would be a purposeless luxury for the species." Death, that is, the limitation of the continuance of life, is not really an attribute of all organisms. There are numerous lower life types, amœbæ, unicellular algæ, infusoria, etc., which are not necessarily subject to it. They are not, of course, indestructible; heat or corrosive agencies will decompose their tissues, but as long as the necessary conditions of life persist they do not die; they have within themselves the capacity of indefinite life. They multiply by fission, and if the amœbæ were endowed with self-consciousness, there can be no doubt that after the fission each new cell would regard itself as the parent of the other. But since, according to the Darwinian theory, multicellular organisms spring from unicellular, the question arises, How has this capacity for eternal life been lost?

This is probably the result of the specialization of function of the several cells in a multicellular organism. We may divide the cells in such an organism into two opposing groups, the somatic and the propagating—the individual and the reproductive cells. The latter could not lose their capacity for unlimited multiplication without danger to the species; but that the somatic cells should gradually lose their power of unlimited multiplication, that they should be limited to a prescribed if even to a great number of cell generations, is explained by the impossibility of the individual cell guarding itself absolutely against accidents, and by its consequent perishableness. Unicellular organisms were exempted from death by the fact that the individual and reproductive cell were one and the same; in higher organisms the individual and reproductive cells were differentiated, death became possible, and the unlimited duration of the life of the individual superfluous; and the inexorable laws of natural selection left it, like every other superfluity, to disappear.—*Die Nation (Berlin); Public Opinion.*

Cars Driven by Compressed Air.

In a recent paper by M. Victor Popp, of Paris, the author described the compressed air system used for propulsion on the Nantes tramways and on the line from Paris to Nogent-sur-Marne. On the latter line each car is fitted with nine steel storage reservoirs fixed underneath the car body, containing air at a pressure of 100 lb. to 176 lb. per square inch. Three of the reservoirs form a reserve in cases of emergency. The air is heated on its passage to the motor by hot water, which at starting has a temperature of 300 deg. Fah. The cars seat 50 passengers, and weigh upward of 14 tons. They will run 12 miles with a single charge on the level, but owing to the heavy grades one charge suffices for but 8⅝ miles, the consumption of air being 35 lb. per mile on the grades and about 24 lb. on the level. One objection to this system of traction is the great weight of the reservoirs. By providing for the automatic recharging of these reservoirs at feeding points distributed along the line, M. Conti has succeeded in reducing the weight required very materially. The feeding points are placed at intervals of about 1¼ miles, and the car as it runs over the points automatically makes connection with mains supplied from a central station, a stop of a few seconds only being required to fill the reservoirs.

Big Money in Ambergris.

The Sydney *Bulletin* is responsible for the following ambergris story: Two years ago one of Macgregor's (Tasmania) whaling captains, having cut the blubber from a whale, was about to cast the rest of it adrift, when there came alongside two Hobart fishermen—"Portuguese Joe" and his mate, an African negro. The Portuguese begged to be given the carcass, so that they might tow it ashore and make what they could out of it. "All right," said the skipper, with the generosity of a satisfied exploiter who knew the blubber business to its omega. Joe, having got the leviathan's framework on the beach, began to search for ambergris, which drug was quoted at that time in the current price lists at somewhere about $65 per ounce. He found 174 pounds. Many people interviewed him, and wanted to give him $25,000 to $45,000 for the lot; but the man understood the luck of his find.

Meanwhile the ambergris was lodged in a bank, which was presently served with an injunction on behalf of the Macgregor firm to restrain the sale of the precious prize pending a discussion on the ownership. But these legal fireworks fizzled out, and the ambergris is still being realized in London, the two fishermen having already received several thousand pounds apiece.

The Austrian poor law gives every man 60 years old the right to a pension equal to one-third of the amount per day which he had earned during his working days.

LANTERN SLIDE ILLUSTRATING SOUND WAVES.

BY GEO. M. HOPKINS.

In demonstrating the theory of sound, it is usual to illustrate the condensations and rarefactions of air which produce sound waves by light and dark bands, which give an idea of the condition of the air at any instant in which it is transmitting sonorous vibrations. But these bands do not represent the progression of the sound waves. For an illustration of this, reference is often made to the concentric undulations produced on the surface of a mill pond by a pebble dropped in the water. This depends for its value upon the student having noticed the mill pond phenomenon and upon his ability to realize that these spreading rings relate only to the feature of progression as it would present

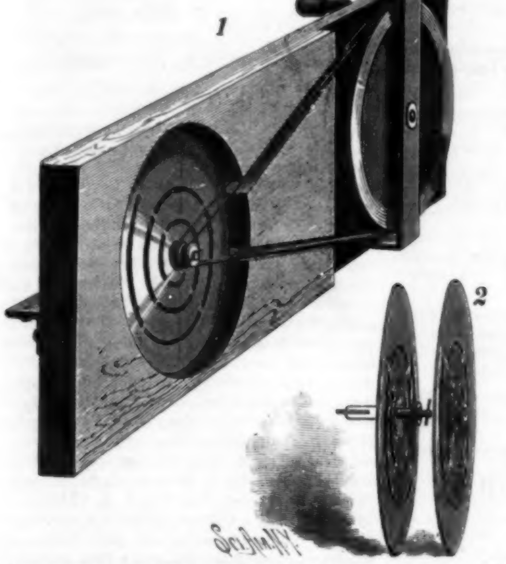


Fig. 1.—SLIDE FOR ILLUSTRATING CONCENTRIC WAVES.

itself in a section taken through a sound sphere in any plane that would intersect the center of the sphere at which is located the source of sound.

The mechanical slide shown in Fig. 1, when projected, is capable of producing on the screen a series of concentric rings of light and shade, representing the condensations and rarefactions of a succession of sound waves, and these waves, beginning at the center, constantly enlarge in circumference until they disappear at the periphery of the disk. This effect is produced by means of two thin metal disks arranged to revolve on the same axis, and each provided with a spiral slot extending from center to periphery, the slot of one disk being oppositely arranged with respect to that of the other disk. One disk is secured to a sleeve which fits on a stud supported by a fixed bar extending across the opening of the slide. The other disk turns on the sleeve. The sleeve and the disk which turns upon it are each provided with a small pulley. One of these pulleys is slightly larger in diameter than the other, so that when the two disks are projected and revolved rapidly in the same direction, one turning at a very slightly increased speed causes the points of intersection of the spiral slots to move outwardly and thus produce on the screen a series of light rings, which increase in diameter like mill pond waves. To cause the light rings and intervening dark rings to blend into each other, the slide is thrown a little out of focus.

To show interference of sound waves two images of

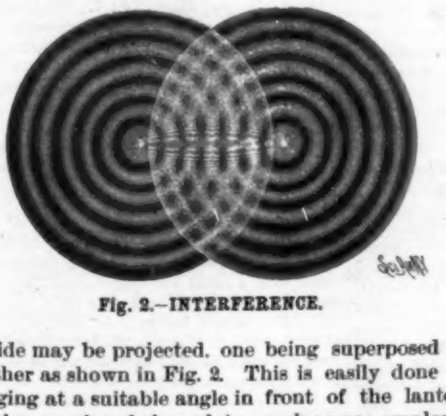


Fig. 2.—INTERFERENCE.

the slide may be projected, one being superposed on the other as shown in Fig. 2. This is easily done by arranging at a suitable angle in front of the lantern objective a series of glass plates, such as are employed in a glass plate polarizer, as in Fig. 3. A portion of the beam is transmitted, forming one image on the screen, and a portion is reflected upward and intercepted by a mirror which throws it upon the screen, forming a second, which may be made to coincide with the first, or it may be made to overlap the first image so as to produce the interference effect shown in Fig. 2. In this case the centers or wave sources are separated more than the semi-diameters of the disks, and the interfering waves approach each other from opposite directions. In Fig. 4 are shown, diagrammatically, superposed wave disks with centers one wave length apart. The waves' "crests" coincide, and re-enforcement along a line joining the two centers is the result. If the centers were a half wave length apart, the "crests" would alternate and one set of waves would neutralize the other.

In Fig. 5 are shown diagrammatically two disks of different size produced by dividing the beam before it passes through the objective, projecting the two parts of the beam with objectives of slightly different power. In this case, owing to the difference in the size of the disks, the relative velocities of the wave rings differ, so that the waves of one series overtake the waves of the other series at *a*, thus illustrating the phenomenon of beats.

The Decline in Price of Electrical Equipments.

In commenting on the business situation and the decline in prices of electrical apparatus, the *Electrical Review* says: "Six years ago the price for a complete equipment for a trolley car, including two motors, was about $4,500. This price held for a year and a half and then dropped to $3,850, $3,500 and $3,300, until two years ago it was about $2,850. One year ago $2,000 was the price of the same equipment, greatly improved in quality and efficiency, while to-day the average price is between $1,000 and $1,200. We have been told of an electric railway manager who desired quite recently to purchase an equipment for a single car. He wrote to seven manufacturing companies, and immediately was called upon by seven salesmen, all of whom had paid traveling expenses to try for the order. The prices quoted ranged from $1,500 to $640. The manager bought the $640 apparatus. Here we have a decrease in actual selling prices from $4,500 in 1888 to $640 in 1894, a period of six years. In 1888 there were seven electric railways in the United States. In January, 1890, there were 162 electric railways in operation and in process of construction. In January, 1891, this number had grown to 281, while to-day there are probably over 500 cities in the United States equipped with electric roads, many of them of great mileage, as in Boston, Brooklyn, St. Paul, Minneapolis and Cincinnati.

"This marked reduction in the price of railway apparatus during the short period of six years is due largely to competition between manufacturing companies, but chiefly to a reduction in the cost of manufacture, accompanied by an increase in the quality of the product. The margin of profit on the equipment mentioned at $4,500, in 1888, was not as large as it was on a better equipment at $2,850, in 1892, owing to the reduction in the cost of manufacture. While prices have been fearfully cut during the last year by all the manufacturing companies, partly due to intense competition and partly to the business depression, we do not believe that any company can make and sell a satisfactory car equipment for $640 and clear a profit on it."

The Nickel Armor Plates.

Speaking of the recent failure of a Harveyized plate, the *Engineer*, London, says:

"There is nothing surprising in this result. With very thick plates terrible disappointments have taken place in our own country. We have known a case where visitors were specially invited to witness a trial and when the disappointment was most crushing, but we did not telegraph the result to America. This was many years ago, and we have since that had further experience with very thick plates, much more than has been acquired in the United States. There has been one remarkable success reported in America with 14 inch Harveyed nickel steel. We expressed our surprise and admiration at it. Our own makers have not as yet obtained so successful a result with thick armor, and having thus expressed ourselves, it is not to be expected that we should be surprised when thick Harvey armor falls short of such a standard. . . .

"The actual measure of the failure, as shown by calculation, is as follows: The first blow represented a perforation of 18·7 inches of iron only. The second blow represents on the English system 25⅛ inches of iron, or 20¼ inches of steel, and on Krupp's system 27½ inches of iron, or 22 inches of steel. It was sanguine, indeed, to expect this 18 inch plate to stand the second blow, but it undoubtedly should have borne the first if its quality had been anything approaching to that of the thinner plates. In the light of past experience with thick armor, however, we think very little of the matter, and are inclined to believe that the United States authorities will have to lower their standard, or else that the Indiana and her sisters will wait a long time for their armor. We have before noticed the admirable behavior of Carpenter projectiles, which are perhaps the best we have seen of large caliber.

"We are not taking a popular view in speaking as we do. But are our readers aware that in testing samples systematically for acceptance of the supply of 18 inch plates, the United States authorities are doing what has not been done in this country, and we doubt if it has been done in any country? Individual 18 inch plates we have undoubtedly tested at Shoeburyness, but the regular selection of samples for the acceptance test of 18 inch armor has, we think, not been attempted as it has been with the thinner kinds, for which only, provision exists on board the Nettle. The United States authorities have instituted a system of inspection and tests of armor which aims at a completeness and at a standard not attempted elsewhere. They have been hoodwinked and met with disappointment, but let us make no mistake in the measure to which the disappointment extends.

"Until recently, the United States had produced plates which defied all comers. Then our own Sheffield makers were literally "put on their metal." Mr. White took steps and made such arrangements that we pushed on without hinderance, employing Harvey's process in combination with the much more complete system of water chilling which had been patented by

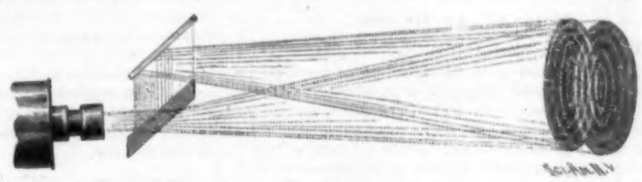


Fig. 3.—ARRANGEMENT FOR PROJECTING TWO IMAGES OF THE SLIDE.

Tresidder, whose patents, we understand, have held good on the Continent, where Harvey's have failed. We hold that what was then done in England can hardly be too highly praised. We have since that time obtained results with treated steel armor of medium thickness that will compare with anything. It was the successful Vickers treated plate that finally led us on our present path. Cammell and Brown have since produced the first-class armor to which we refer. Mr. White decided—and, we were inclined to believe, rightly decided—to discard nickel, and recent events, as far as they go, bear this out. We hope that at the present moment we have taken the lead again in armor, but we cannot say more than 'hope' until we have had a fair competitive trial with America."

Photo Etching on Copper.

As explained by Mr. Calmels, the polished copper plate is sensitized with the following solution:

Fish glue	2 oz.
Albumen	2 oz.
Water	4 oz.
Ammonium bichromate	60 grains.

The plate is then placed on a whirler so as to produce evenness of coating, and remove the superfluous solution. After drying, the plate is ready for exposure under the negative, which, of course, has been associated in the camera with a lined screen. In this case it may be mentioned the screen used had 135 lines to the inch. The exposure necessary for a copper plate prepared in the way described is about two minutes to direct sunlight. Development is brought about by simple washing in water, which dissolves out the coating solution where the light has not acted. It will be observed that no rolling up with printing ink is necessary, as in the case of a zinc plate etched in acid. The

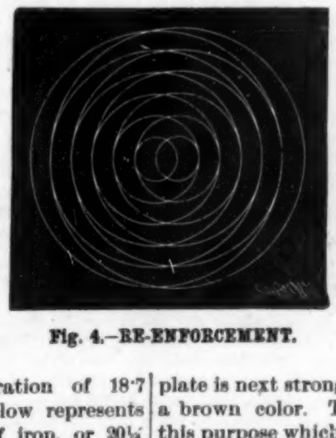


Fig. 4.—RE-ENFORCEMENT.

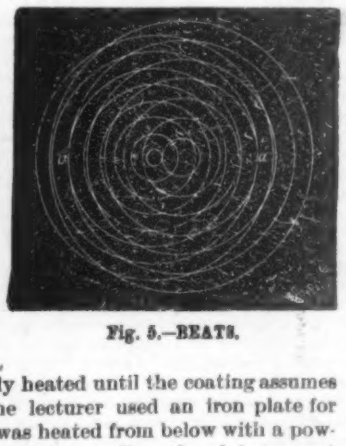


Fig. 5.—BEATS.

plate is next strongly heated until the coating assumes a brown color. The lecturer used an iron plate for this purpose which was heated from below with a powerful Bunsen burner. After cooling, the plate was put into an ordinary porcelain developing dish and covered with an etching solution of perchloride of iron (strength 30° Baume). The coating was evidently of a very tough nature, for the lecturer rubbed its surface with a pledget of cotton wool while in the bath. At the end of about a quarter of an hour the etching operation was complete, when the plate was washed, dried, and a proof in printing ink of a very satisfactory nature, considering that hand pressure only was applied to it, was quickly obtained.—*Photographic News.*

SOME words in the Chinese language have as many as forty different meanings.

RECENTLY PATENTED INVENTIONS.

Engineering.

SMOKE ARRESTER.—William P. Shank, Cairo, Ill. This invention comprises a water tank and collecting chamber, with nozzles leading from the chamber to the tank, and blast devices discharging into the tank for the separation of the soot, the nozzles opening below the surface of the water and having contracted discharge openings. The invention is designed to effectually stop the emission of heavy products usually discharged in smoke from furnaces.

COAL CHUTE.—John Scully, South Amboy, N. J. This invention relates to chutes for discharging coal from cars into vessels, coal bins, etc., and provided with screens over which the coal passes. The chute is supported on the usual framework, with tracks and openings between the rails for dumping the coal into pockets, in connection with which is an adjustable sliding gate, arranged below which is a screen bottom, while a lower or swinging chute is hinged to the fixed chute. The pitch of the swinging chute may be arranged as desired, and the stream of coal is somewhat retarded, so that while an even and not too large quantity of coal will be run steadily over the screen, the coal will be kept and delivered in good condition.

Railway Appliances.

CAR BRAKE.—John Mayer, Amsterdam, N. Y. According to this improvement peculiarly constructed frictional contact blocks are supported above the track rails near the car wheels, and means are provided to rock the blocks to cause them to have more or less bearing on the top faces of the rails, the faces of the blocks acting in a measure as cams to lift the car body from the track, and, in cases of extreme urgency, thus lifting the entire weight of the car upon the brakes.

FREIGHT CAR.—John J. McClimont and Peter Marron, Aspen, Col. A simple device applicable to the roof of a box car has been provided by these inventors, so that openings in the roof may be easily made when necessary to facilitate loading and unloading, but such openings may not be made from the exterior of the car. The covers of these openings are so arranged that in connection with an ordinary chute they will form a hopper through which grain, ore or other freight may be loaded on the car, and a simple lock is provided for fastening the covers to the openings on the inside of the car.

RAILROAD RAIL OR TIE DISTRIBUTER.—Caleb C. Gates, Forsyth, Montana. This is an attachment for a car adapted to carry rails or ties, consisting of a series of roller sections and supports adjustably and removably connected, whereby the distributer may be made in any desired number of sections, readily coupled together and rigidly held at the desired angle. The speed of the material passed over the distributer may also be regulated, and the rails be directed either to the right or the left in discharging them.

Mechanical.

WRENCH.—Archibald McCallum, Conrad, Pa. This is a quickly adjusted and convenient tool in which the handle and head are adjustably connected to enable the handle to be placed at the desired angle to the head. This adjustment of the handle may be easily effected, and provision is made for working the wrench as a ratchet wrench in either direction, the head being locked at any angle in fixed relation to the handle, against movement in either direction.

CLEAT.—John C. Steelman, Linwood, N. J. This inventor has provided a clamp consisting of a body with a recess or mouth in one of its ends and inclined lower roughened wall, a jaw eccentrically pivoted in the mouth having a concaved ribbed lower face. The improvement forms a simple, strong and inexpensive device adapted for use wherever the clamping of a rope is required, the cleat biting the rope or cable forced in contact with it.

LEATHER STRIPPING MACHINE.—Michael J. Ryan, New Orleans, La. This machine is adapted to cut an entire side of leather into a series of strips of a desired width at one time, the leather being properly fed and guided and the strips smoothly and rapidly cut. The machine has a pair of feed rollers, the upper one with projecting bearing faces, and mounted above it is a swinging bar, to which is secured a number of downwardly projecting and laterally adjustable knives. The leather as cut is delivered in parallel strips at the rear end of the table.

MATCH MAKING MACHINE.—Henry A. La Chicotte and Walter B. La Chicotte, New York City. The veneers of wood fed to this machine are cut into splints of the desired cross section, and the splints are fed to an apparatus which cuts them of a uniform length, the splints before being cut being engaged by gripping devices which carry the splints after being cut to an oil or paraffine bath, and next to a bath of an ignitable compound, finally removing them to be dried and delivered to a suitable receptacle, the operation being continuous and automatic after the veneers have been once fed into the machine.

Agricultural.

POTATO DIGGER.—Nathan Sturdy, Chicago, Ill. In this machine an elevator frame and a draught frame are pivoted on the axle on which the two supporting wheels are loosely mounted. An adjustable shovel removes the potatoes from the ground, to be received, together with the vines or roots that may cling to them, by the elevator, which has a vibratory motion, designed to free the potatoes from dirt, etc., and deliver them to a hopper, whence they are directed to receptacles on a platform at the rear of the machine.

TRANSPLANTING MACHINE.—August Willner, Germantown, Ohio. This is an improvement in machines having furrow openers and liquid discharging tanks, with means for closing and smoothing the furrow, whereby the furrow is opened to place a plant therein, the soil is moistened, and the loose earth carried around the roots of the plant and pressed down by a covering or pressure wheel. This machine is adapted to rise and fall according to the inequalities of the ground or to pass an obstruction, being fitted for work on a hill side or on rough ground as well as upon a level.

Miscellaneous.

PHOTOGRAPHIC LENS, ETC.—Henry Vander Weyde, London, England. This invention relates to portrait photography and consists essentially in interposing in the pencil of rays lens-like media of peculiar form, convex or concave, whereby the rays of light will be so refracted as to produce the effect desired, and yet the parts modified will flow into and merge with the surroundings. The media may be interposed either within or without the camera, the curvature and form of the lens-like medium varying according to the desired effect, whereby different portions of a picture may be made larger or smaller, or otherwise artistically modified.

TRIGGER FOR DOUBLE-BARRELED GUNS.—William Fleming, Newberry, Pa. In this firearm a single trigger is combined with two sears, the trigger carrying an adjustable shoulder, adjustable laterally, in connection with a spring for throwing it to a middle position, and locking devices for holding it to either side. The invention is designed to dispense with the necessity for more than one trigger for double-barreled guns, and provide a trigger by which either barrel may be fired independently or both barrels together, or either one in sequence after the other.

SAFETY MATCH.—William Barnhurst, New York City. According to this invention the match splint is detachably connected with a sleeve or envelope, the sleeve having a rubbing compound and the splint an igniting compound, each held normally out of engagement with the other, and yet located one in the path of the other, ignition being effected when the splint is separated and drawn from the sleeve. The two parts are combined in one article forming the match, which is ignited as the splint is withdrawn from the casing.

GATE LATCH.—Gabriel Rohrbach, Del Rio, Texas. This improvement relates especially to latch attachments for swinging gates which move the lock latch vertically as they are swung. The gate has a pivoted latch arranged to engage a catch consisting of oppositely arranged pairs of converging flanges separated to receive the latch, swinging detents being pivoted inside the entrance slots, and a keeper being placed below the lower flanges. The device is very simple, durable, and easily applied.

STOPPER.—Max Rubin, New York City.—This device comprises a shell having an inlet in its bottom and a spout leading from one side near the bottom, while a plug valve fitted to travel up and down in the shell has at its upper end a lip closing over the outer end of the spout when the valve is seated in the shell. The improvement is adapted for use with bottles of any description, cans, or other receptacles, the stopper automatically and perfectly sealing the outlet when seated in its shell.

DISPLAY BOX.—Nicholas Schroder, New York City. A box to conveniently hold scarfs and similar articles in position for shipment and display in stores has been provided by this inventor, the box being strong, simply made, and inexpensive. A flanged holder is secured to the bottom of the box, while triangular projections between the flanges form notches for the reception of the article, tongues extending from one flange nearly to the other.

PENDULUM ESCAPEMENT.—Charles E. Buckbee, Flushing, Mich. The escapement wheel, according to this invention, has on one surface a series of inclined planes extending from near the center to the periphery, the planes being located at stated intervals, and friction rollers on the ends of a crosshead secured on the pendulum rod are adapted for alternate engagement with the inclined planes on the wheel. The construction is durable and simple, and the escape wheel has no recoil.

ICE CREAM FREEZER.—Joseph B. Butler, Brooklyn, N. Y. This is an inexpensive and easily operated machine for readily and quickly freezing individual creams in numerous compartments, creams of dissimilar flavors being thus simultaneously frozen. The several compartments or cups are so arranged that they may be readily removed, and each is hermetically sealed by a cover which prevents contact with the brine or water of the freezer.

CHECKREIN SUPPORT.—Joseph Carter, Blyth, Canada. This is a combined checkrein support and winker stay, the support for the overdraw check effectually preventing the checkrein from wearing upon or rubbing against the head of the horse, while the winker stay is adapted for attachment to the winkers or blinds, which may be held at any desired angle to the animal's head, and be quickly and conveniently adjusted in the required position.

CIGARETTE WRAPPER HOLDER.—José R. Hernandez, Havana, Cuba. This is an improvement on a formerly patented invention of the same inventor for a device for holding and smoothing the wrappers before they are rolled around the filler. A lever is pivotally connected with uprights in a table on which the wrappers are laid, a pedal being connected with the rear arm of the lever and a plunger with its front arm, with which also is pivotally connected a ring, in connection with a guide secured to the table, and a spring bearing on the front arm.

NOTE.—Copies of any of the above patents will be furnished by Munn & Co., for 25 cents each. Please send name of the patentee, title of invention, and date of this paper.

SCIENTIFIC AMERICAN
BUILDING EDITION.

JUNE, 1894.—(No. 104.)

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Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information and not for publication.
References to former articles or answers should give date of paper and page or number of question.
Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.
Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.
Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.
Scientific American Supplements referred to may be had at the office. Price 10 cents each.
Books referred to promptly supplied on receipt of price.
Minerals sent for examination should be distinctly marked or labeled.

(6098) R. B. asks: 1. What is the specific gravity of the vapor of benzine? Is it heavier than air. A. The vapor of benzine or naphtha is heavier than air. Its specific gravity being from 2·0 to 2·5. 2. Mercury boils at 662° Fah. How high a temperature will it record reliably? A. Mercurial thermometers are made for temperatures up to 600° Fah. 3. What are the temperatures required for distilling off benzine, gasoline, kerosene, lubricating oils, and paraffine, and what is the greatest heat required in any process of distilling crude American oil? A. Light benzine boils and distills at from 180° to 200° Fah. Naphtha and gasoline at 250° to 300° Fah. Kerosene, 300° to 390°. Paraffine is separated after the last distillate. About 400° Fah. is the highest heat. 4. What is the difference between paraffine and vaseline? A. Vaseline is the residue from the oil stills purified by filtration. See SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 489, 485, for details of the process, 10 cents mailed. It is virtually a soft paraffine. 5. In distilling crude oil there is a very poisonous gas comes out of the tail pipes. What is it chemically? When there is sulphur and arsenic in the crude oil, do they make the escaping gas any more deleterious? A. There are lighter hydrocarbon gases distilling under 170° Fah. that may carry off vapors of sulphur and other poisonous substances constituting the first gases from the tail pipes. 6. About what proportion of air and benzine vapor is explosive? A. Any proportion of air and benzine or gasoline vapor between equal parts and 1 of vapor to 12 of air is explosive.

(6099) R. M. G. asks: What is the longest distance a cannon has been known to throw a shot? What is the greatest range attained by modern guns? What is the greatest range of the guns (heaviest) of H.M.S. Blake? For what distance are the guns of the Blake sighted? Is there any truth in the statement that a gun is, or has been, chained to the rocks at Dover, England, which threw a shot across the English Channel to Calais? A. Seven or eight miles is probably the greatest range actually made. Twelve to thirteen miles is the computed range of the most powerful guns now made. To obtain this range an elevation of nearly 45° is required. The mounting of the guns of the Blake and other ships carrying heavy ordnance is not intended for the greatest possible range. They can be sighted for ranges up to 7 or 8 miles. Shooting across the English Channel has been commented upon in journals and military circles.

(6100) M. W. asks what kind of paper to put on pulleys to keep them from slipping. Also a recipe for making cement for putting it on. A. Use the toughest wrapping paper that can be obtained. If the pulley has been used and is polished, scratch the face with a coarse file and remove all grease or oil with a solution of sal soda. For the cement use the best glue, soaked and cooked quite thick. When ready to apply the paper, add a half gill of hot strong decoction of oak or hemlock bark to each pint of glue. Have the pulley warm and apply the glue to the paper in strips and wrap tightly on the pulley as many thicknesses as may be desired. Six to eight thicknesses make a good working pulley, durable, according to the severity of the work, from 6 months to 3 years.

(6102) M. L. R. asks: 1. Which is the better for use on a short telephone line, No. 16 hard drawn copper wire or No. 12 galvanized iron wire? A. The copper wire. 2. How many cells of the diamond carbon and how many cells of the Samson battery would it require to ring one bell through a line 1,000 feet length with earth return? A. Allow four to six cells. 3. How much does No. 12 galvanized iron wire weigh per mile? A. 32·7 pounds. 4. Can a common telephone receiver, such as was fully described in the SCIENTIFIC AMERICAN of February 3, 1894, be used successfully as both receiver and transmitter? A. Yes. 5. Will the receiver with the compound magnet give any more volume of sound over a given amount of wire than a receiver with a round bar magnet? A. The compound magnet telephone is the best. 6. What is the charging fluid of the Samson battery? A. Solution of chloride of ammonium. 7. Which is the better for open circuit work and which has the longer life, the Samson or the Diamond carbon battery? A. We cannot undertake to pronounce as to relative merit in such cases. 8. Will you please give me the address of some reliable company where I can get a good receiver at a low price? A. Consult our advertising columns.

(6103) W. A. asks how to determine the amount of current and number of volts necessary to run an electric motor, the size and number of feet of wire being known. I have a small motor; the armature is wound with twelve coils of No. 22 wire, twelve feet in each coil, 144 feet in all, and the fields are wound with 350 feet of No. 18 wire, and I wish to know the amount of current and number of volts it will require to run it to its full capacity. A. The current and voltage required depend on whether the motor is shunt or series wound. If shunt wound, allow all the current the field wire will stand, and calculate by Ohm's law the voltage for this current based on the resistance of the field. If series

wound, then give twice the current the armature wire would stand and apply Ohm's law as above. For electrical calculations we refer you to Sloane's "Arithmetic of Electricity," $1 by mail.

(6104) W. S. E. asks: 1. Introducing a resistance into the field of the dynamo, are the E. M. F. alone reduced or is the E. M. F. and C. both reduced? A. If shunt wound, both are reduced. 2. Has aluminum ever been reduced directly from common clay? A. Not to any great extent. 3. Give chemical formula for the hydrated oxide of aluminum. A. $Al_2(OH)_6$. 4. In the electrolysis of a compound body, what disadvantage, if any, is there in employing an electromotive force greatly in excess of the E.M.F. necessary to effect the decomposition? A. None except perhaps wastefulness of energy. 5. What is the present market price of aluminum? A. About $1 a pound.

(6105) H. G. K. asks: Kindly inform me of the method of obtaining the amount that a safety and high wheel is geared to. And supposing it is 60, what is the denomination of 60? A. For a safety count the teeth on the sprocket wheels, divide the number on the crank axle sprocket by the number on the driving wheel axle, and multiply the diameter of the driving wheel by the quotient. We do not understand what you mean by the other query about the high wheel. If you refer to a geared ordinary or front driver, try how many times the front wheel revolves for one revolution of the pedal and multiply the diameter thereby.

(6106) B. asks (1) how to construct a simple, long-lived, effective battery for bell work. A. Make a sal-ammoniac zinc carbon couple with large area of carbon. 2. How many cells and what number copper wire will be required to operate one bell, 50 foot circuit? A. Wind with No. 22 or 24 wire, using two or three ounces. 3. Where can I purchase shell, diaphragm, etc., for telephone described in SCIENTIFIC AMERICAN of February 3, current year? A. Address some of our advertisers who sell telephones.

(6107) R. W. R. asks: 1. What should be the voltage and amperage of a current to run 641 motor to best advantage, the armature being wound with No. 16 wire, having 4 layers of 7 convolutions each to each coil? A. Eight or ten amperes and seven volts. 2. What would be the resistance of water in a glass tube of half inch inside diameter for each inch between electrodes? A. It depends on size of electrodes and on the purity of water. 3. Would the armature core of 641 motor answer as well, made of No. 14 iron wire instead of No. 18, also would it make any difference if the wire was not all one piece, or must there be perfect connection through its entire length? A. Any wire will answer. It need not be continuous. 4. I notice in making the mixture of 4 parts resin, 1 part gutta percha, and a little boiled oil, for coating wooden battery cells, that unless the amount of boiled oil is extremely small, the solution will not harden; is this due to a bad sample oil, would not paraffine answer instead of oil? A. Use oil. Be sure it is boiled oil. You might add some liquid drier.

(6108) G. F. D. asks: 1. Which has relatively the most conductivity, viz., a No. 16 galvanized iron wire or a common fuse wire of exactly the same size as iron wire? A. If of lead, the fuse wire has least conductivity. 2. In building a metallic circuit telephone line with No. 16 galvanized iron wire, what size fuse wire should be used for safety cut-outs? A. Use fuse wire of the diameter of the copper house wire.

(6109) L. P. asks: 1. In what number of the SCIENTIFIC AMERICAN was the induction coil for alternating currents described? A. Vol. 68, No. 10. 2. Can the coil give an alternating induced current without stoppage while the primary circuit is closed? A. Yes. 3. What firm makes a transformer to change a low voltage to a high voltage? A. Address any of our advertisers of electrical goods, such as J. H. Bunnell & Co., 76 Cortlandt Street, New York. 4. Does the amperage of a transformed current rise with the voltage or not? A. Yes, if a circuit of low impedance is open for it.

(6110) R. W. S. asks: 1. Will you please inform me how to find the amperes of an incandescent lamp or an arc lamp, only knowing the candle power? A. You cannot unless you have also the voltage. Allowing 3 watts to the candle power, you can calculate the amperage if you have the candle power and voltage. 2. Will six cells sal-ammoniac battery charge a storage battery, 4 plates, 3×3½? A. No. 3. What kind of acid would you use in a storage battery? A. Sulphuric acid. 4. Is there any kind of closed circuit batteries not using strong acids? A. The Daniell and similar combinations use copper sulphate and no acid.

(6111) E. F. B. asks: In your issue of May 26 I find an article on "Hard Water," from *The Asclepiad*. To soften hard water, the addition of lime water is recommended. The water of this section is already surcharged with lime, and it would seem like "carrying coals to Newcastle," to add more. Does not the article refer specifically to Great Britain, with its chalk deposits? A. The softening process alluded to is designed for water charged with calcium bicarbonate. For gypsum-charged water it is ineffectual. We presume that your region has water of the latter type. See next query.

(6112) W. A. C. writes: In your issue of May 26 is an article by Sir B. W. Richardson, "How to soften Hard Water by the Use of Lime." I always supposed hard water was caused by its being already impregnated with lime. In one of your issues will you kindly explain how this can be? A. Hard water may be charged with calcium sulphate (from gypsum rocks) or with calcium bicarbonate. If the latter is present, the addition of calcium hydrate or lime will produce calcium carbonate. The latter is insoluble and will be precipitated. The reaction is $CaH_2(CO_3)_2 + Ca(OH)_2 = 2CaCO_3 + 2H_2O$. The $CaCO_3$ is precipitated.

(6113) W. P. C. writes: What difference does it make if a receiver is wound to 75 ohms? Will it work as well on a short line as it does on a long line, and what does the resistance have to do with the working of the telephone? A. Resistance does not help, but injures the working of a telephone. The statement of "resistance 75 ohms" is merely a convenient way of prescribing how much wire shall be wound on it. The working is due to the turns of wire; if the resistance could be zero, it would be all the better. The turns of the telephone coil are needed for short or long line connections.

(6114) W. A. H. writes: If two electro-magnets are mounted on a base, each provided with an armature, connected to the same lever, the lever pivoted between the two magnets (walking beam style), and one pair of magnets excited by a battery to an attractive strength of 2, which will hold the seesaw lever against it, or as close as an ordinary telegraph sounder armature is held? Now, if the other pair of magnets be excited to an attractive strength of 3, can it overcome the attractive force of the first pair, and draw the lever in the opposite direction? A. It is a question of relative distance. If the lever has any amount of play, it will stay attracted by the magnet whose poles it nearly touches.

(6115) E. S. asks what difference there is between an electric horse power and the horse power relating to steam engines. A. The electric horse power is equal to 746 watts or volt-amperes, the steam horse power to 33,000 foot pounds per minute; one is convertible into the other.

(6116) H. R. E. asks: In purifying a mineral (clay) I am using hydrochloric acid. What will entirely remove the acid or neutralize its effect? A. Washing with water or neutralization with dilute caustic soda solution.

(6117) F. P. R. asks: By whom and when was the first piano made on this continent? A. Jonas Chickering was the pioneer maker, beginning in 1822, and exposing his first piano for sale in Boston April 15, 1823. Previous to this some unimportant attempts at piano making, it is said, were made.

(6118) J. W. B. asks how to obtain the gold from a solution of its alloys in nitro-hydrochloric acid. A. Ferrous sulphate, oxalic acid, and many other reducing agents will precipitate metallic gold from the solution of its chloride.

(6119) C. A. C. writes: I have just finish-ed an 8 light dynamo described in SUPPLEMENT 600 and it works to perfection. 1. How can I make a nickel plating tank, and what is it painted with inside? A. Smear wooden cell, when perfectly dry, with a cement of 4 parts resin, 1 part gutta percha, and a little boiled oil, melted together. 2. What amperage should dynamo give for general plating? A. One tenth ampere per square inch of electrode at starting, dropping to one-fifth this amount after starting. 3. I have a sparking coil made with one inch core of fine wire wound with six or eight layers of No. 14 D. C. magnet wire and is 8 inches long. I run it with four large bichromate potash cells, but it does not give enough spark to run my gasoline engine. A. Your coil needs more turns of wire; simply add ten to twenty layers of No. 20 wire. The length of spark is due to number of turns of wire; a small wire is not as good as a coarser one. It might pay better to remove the large wire, and rewind with thirty or forty layers of No. 29. The latter is coarse enough.

(6120) J. C. P. and S. write: We have built the 8 light dynamo as described in SUPPLEMENT, No. 600, winding field magnets each leg with four layers No. 12 magnet wire. One leg of the magnet seems very soft iron and the other appears harder, as though they were not both cast at the same time. It runs very nicely as a motor, but as a dynamo will run one 52 volt lamp at only about half its candle power, and when more lamps are connected it will not light them at all. Running at 2,600 per minute, one lamp and volt meter in circuit, meter shows 35 volts. Can you give us information that will help us out of our difficulty? A. You may have either too weak a field or too few turns on your armature. The relation between armature and field resistances depends on external resistance and on whether the connections are in shunt or series. The difference of hardness of the two arms may affect the working of the dynamo.

(6121) W. L. B. asks: Which would be the most economical to use as power, compressed air "dry" or a vacuum power? In producing vacuums, is there a loss corresponding to the heat generated in compressing dry air? A. Compressed air is more economical than a vacuum for power purposes. A larger range of pressure can be used with compressed air and with less loss from engine friction than with a vacuum. There is loss in heat by expansion and consequent shrinkage of pressure, alike in both systems; with the additional disadvantage of limited pressure practically below 12 pounds in the vacuum system.

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Medicinal and chemical compounds, certain named, C. F. Boehringer & Sohne....... 24,909
Medicine and tonic, nerve, Magic Medicine Company....... 24,868
Oils for external use for veterinary purposes, compound of lubricating, W. A. Lowe....... 24,864
Perfumery, Indianapolis Drug Company....... 24,845
Pharmaceutical preparations, S. Radlauer....... 24,866
Pills, C. I. Hood & Company....... 24,865
Polish, metal, Harvey Chemical Company....... 24,845
Remedies, certain named, E. & A. L. Wood....... 24,870
Remedy for chilblains, Lens Ku-Ra-Tiv Company....... 24,873
Remedy for rheumatism, W. J. Gardner....... 24,871
Remedy for rheumatism, J. Keen....... 24,872
Repellents or waterproof cloth, Dexter Woolen Mills....... 24,843
Safes, iron and steel fireproof, M. J. Sanchez....... 24,881
Sateens and twills for dress and lining purposes, Loeber, Whitman & Company....... 24,840
Sheetings and shirtings, brown and bleached, Dudley, Battelle & Hurd....... 24,841
Shoe dressing, liquid, C. L. Hauthaway & Sons....... 24,847
Soap, bar, J. Biechele Soap Company....... 24,851
Starch, made of potatoes, burned, B. P. Ducas Company....... 24,863
Suits, children's, Bowiby & Company....... 24,838
Tobacco pipes, L. Naz....... 24,875
Vessels for physicians' and surgeons' use, L. A. Dessar....... 24,878

PRINTS.

"Dr. Kilmer Swamp Root," J. Ottomann Lithographing Company....... 3

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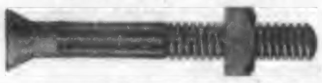

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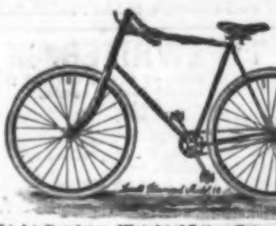

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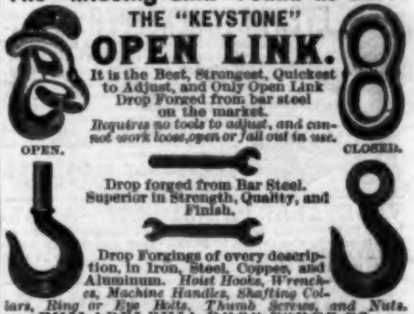

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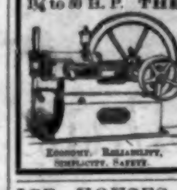

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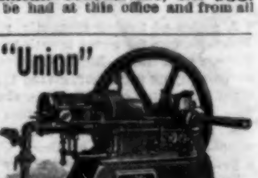

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